To: Harry Barber[hbarber@blm.gov]; Ashley King[aaking@blm.gov]
Cc: Matthew Betenson[mbetenso@blm.gov]; Cynthia Staszak[cstaszak@blm.gov]; Larry Crutchfield[lcrutchf@blm.gov]
From: Beal, Jeffrey
Sent: 2017-11-06T16:19:02-05:00
Importance: Normal
Subject: Wingate Wilderness Therapy - SRP Expires December 2018
Received: 2017-11-06T16:19:31-05:00
GSENM Final Report 3_17_17_Monitor_Record_BkCountry_Impacts.pdf
GSENM_Backcountry Inventory Impacts_Phase 1 Report – Executive Summary.pdf
GSENM_2016_Wingate_night_only.pdf

Harry: I am following up on a conversation we had a few weeks back regarding Wingate. Wingate's SRP expires on GSENM at the end of 2018. In 2016 I opened an assistance agreement with Penn State University (Post NAU, Pam Foti) to monitor Recreational and back-country use. In 2016 the focal area was the Nephi Pasture region of the monument. Based on the 2016 monitoring season, Penn State produced the following report and maps.

A review of the GSENM-2016-Wingate-Night-only map shows the disbursement of use on GSENM and KFO. The map clearly shows trends for both resource areas.

I wanted to pass this information along and make sure you are aware of the upcoming Wingate SRP renewal/NEPA process. GSENM has identified a number of points for improvement, including the improvement of reporting visitor use and revenues on which BLM fees are calculated. It would be good to have a unified approach as we move forward.

Contact me with questions. Have a good day.

Jabe Beal, Outdoor Recreation Planner
Grand Staircase - Escalante National Monument
Escalante Interagency Office
PO Box 225
Escalante, Utah 84726
(435) 826-5601 wk.

Collaborative Research to Monitor and Record Backcountry Use Impacts at GSENM

Dr. Jeremy Wimpey
Applied Trails Research

Dr. Derrick Taff
PennState College of Health and Human Development
Protected Areas Research Collaborative (PARC)

Dr. Jeff Marion
USGS science for a changing world
Virginia Tech College of Natural Resources and Environment

Phase 1 Report – Executive Summary
Inventory and Monitoring of Backcountry Sites in Southwest GSENM
March 2017

Purpose

The purpose of this executive summary report is to briefly describe the first of five phases of research, which aim to provide the continued inventory and monitoring of recreation impacts within the backcountry and dispersed areas throughout Grand Staircase-Escalante National Monument (GSENM) (see Taff, Marion, Wimpey (2017) "Inventory and Monitoring of Backcountry Sites in Southwest GSENM Phase 1 Report" for full-length report).

Methods

Researchers collaboratively developed an inventory protocol and sampling strategy with Monument staff to collect recreation-related impact data in the southwest portion of the Monument during September of 2016. Data collection focused on revisiting sites that had been previously evaluated and monitored by other researchers, as well as backcountry sites that had been used by WinGate Wilderness Therapy Program (a commercially permitted entity with heavy presence in this area of the Monument), during 2014, 2015, and 2016, in the southwest portion of the Monument. The researchers used data points and GPS coordinates from the reports generated by other researchers to reevaluate the previously inventoried backcountry, largely primitive roadside, campsites. Additionally, the researchers used SPOT data, in the form of GPS coordinates from the WinGate Program, to locate a subset of campsites used by the organization during 2014, 2015, and 2016. A data dictionary of indicators of impact (e.g., ecological disturbance to the resource) were developed collaboratively by the researchers and GSENM staff, to assess and document impact levels at each campsite in the sample.

Results and Discussion

Previously Evaluated Backcountry Campsites

A total of n=33 previously evaluated backcountry campsites (PEBCs) campsites were located and evaluated during the sampling period. The majority of PEBCs (most often roadside campsites) were considered to have low (~55%) or moderate (~42%) levels of visitor use impact. However, the majority of PEBCs (~67%), were located in areas that had 75-100% potential for site expansion, given the landscape features surrounding the sites. Evidence of fire, litter, and trails leading to and from the sites were common impacts discovered by the researchers. Additional data collection in subsequent phases of this research will allow for more robust comparable analyses. Although, currently, continued monitoring, as well as additional direct and indirect strategies (e.g., education and communication) are warranted to ensure that visitors using these sites are compliant with management objectives. In particular, management

strategies to ensure that sites do not expand, as well as approaches to reduce avoidable impacts will be pertinent at these campsites.

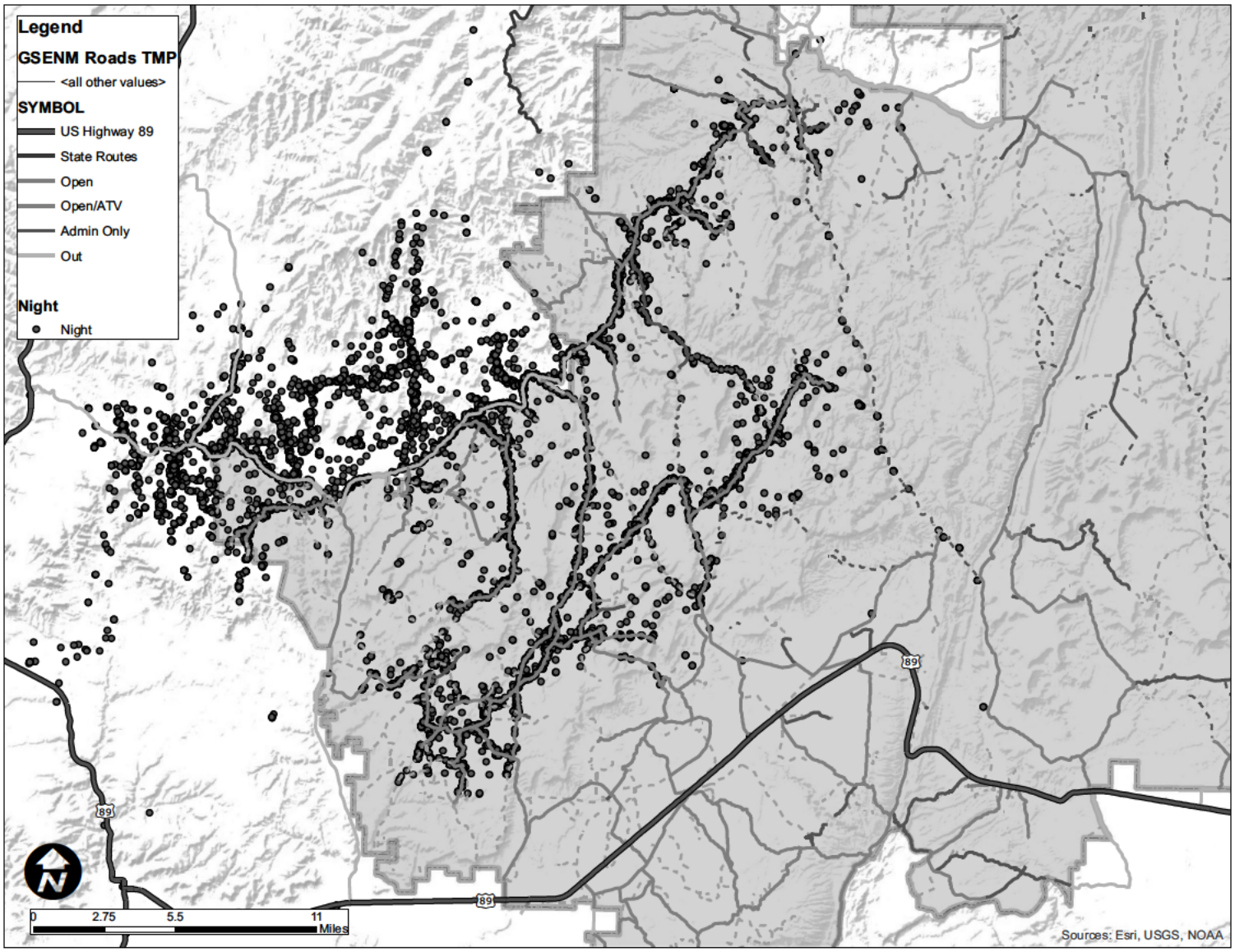
WinGate Campsites

The researchers were able to locate and evaluate n=135 of the camping locations used by WinGate Wilderness Therapy. Generally, WinGate sites were readily evident due to the common impacts specific to the Program's use. Commonly, WinGate campsites are located near, but removed from, the primitive road system, generally lacking connecting informal trails. The Program's groups frequently camp near roads to facilitate the delivery of food, water, and supplies, as well as trash removal. Several forms of notable, but largely avoidable impacts were commonly observed at WinGate sites, such as stripped bark from cedar trees, the presence of charcoal but absence of a fire site, and several unique, WinGate-associated types of litter (e.g., p-cord, tuna wrappers, etc.). At approximately 83% of the WinGate sites, researchers documented notable, visible impacts. Most of these indicators are "avoidable" forms of impact when campers apply low impact practices applicable to dispersed "pristine site" camping (Marion, 2014), which are largely advised in the low impact guidance contained in WinGate's official staff manual (WinGate, 2016). Finally, only 44% of the sampled WinGate sites were occupied a single night, though it is likely that some were used in the years preceding 2014. Approximately 25% of the sites were assessed <9 months after use, 20% were assessed 9-21 months after use, and 39% were assessed 21-33 months after use. Based on these results, nearly 60% of the WinGate campsites should have recovered to near-natural conditions if impacts were kept at or below levels able to recover in a one-year period.

Results suggest that there is a disconnect between what is being taught and prescribed in the WinGate staff manual, and the practices taking place in the field. Strategies to ensure that field staff and participants follow the low impact camping practices included in the manual, along with a program of random field checks to ensure future accountability is merited. Findings indicate that a substantial amount of repeat use is occurring, which is creating lasting impacts that do not recover in a single year. For dispersed pristine site camping to avoid creating lasting resource impacts, we suggest that WinGate staff attempt to camp at each location only once a year, avoiding all spots that exhibit prior evidence of camping. Results indicate that this is not currently WinGate's practice.

We suggest that WinGate develop additional low impact policies that incorporate improved dispersed pristine site camping practices and established site camping practices that concentrate use on sustainable sites that receive repeat use. Recreation ecology research

indicates that concentrating repeat use on a single site within each area will result in far less cumulative impact than would camping many times per year on a larger number of dispersed campsites (Marion 2016). Thus, the results of this project suggest that within each commonly used area, WinGate could identify a designated campsite for use whenever they are unable to move each night, and use only that site when repeated camping at one location is necessary.



Collaborative Research to Monitor and Record Backcountry Use Impacts at GSENM

Dr. Jeremy Wimpey
Applied Trails RESEARCH

Dr. Derrick Taff
PennState College of Health and Human Development
PROTECTED AREAS RESEARCH COLLABORATIVE (PARC)

Dr. Jeff Marion
USGS science for a changing world
VirginiaTech College of Natural Resources and Environment

Phase 1 Report

Inventory and Monitoring of Backcountry Sites in Southwest GSENM

March 2017

Executive Summary

The purpose of this report is to describe the first of five phases of research, which aim to provide the continued inventory and monitoring of recreation impacts within the backcountry and dispersed areas throughout Grand Staircase-Escalante National Monument (GSENM). Researchers collaboratively developed an inventory protocol and sampling strategy with Monument staff to collect recreation-related impact data in the southwest portion of the Monument during the fall of 2016. Data collection focused on revisiting sites that had been previously evaluated and monitored, as well as backcountry sites that had been used by WinGate Wilderness Therapy Program (a commercially permitted entity with heavy presence in this area of the Monument), during 2014, 2015, and 2016, in the southwest portion of the Monument.

The majority of previously evaluated backcountry campsites (PEBCs) (most often roadside campsites) were considered to have low (~55%) or moderate (~42%) levels of visitor use impact. However, the majority of PEBCs (~67%), were located in areas that had 75-100% potential for site expansion, given the landscape features surrounding the sites. Evidence of fire, litter, and trails leading to and from the sites were common impacts discovered by the researchers. Additional data collection in subsequent phases of this research will allow for more robust comparable analyses. Although, currently, continued monitoring, as well as additional direct and indirect strategies (e.g., education and communication) are warranted to ensure that visitors using these sites are compliant with management objectives. In particular, management strategies to ensure that sites do not expand, as well as approaches to reduce avoidable impacts will be pertinent at these campsites.

The researchers were able to locate and evaluate 135 of the camping locations used by WinGate Wilderness Therapy. Generally, WinGate sites were readily evident due to the common impacts specific to the Program's use. Commonly, WinGate campsites are located near, but removed from, the primitive road system, generally lacking connecting informal trails. The Program's groups frequently camp near roads to facilitate the delivery of food, water, and supplies, as well as trash removal. Several forms of notable, but largely avoidable impacts were commonly observed at WinGate sites, such as stripped bark from cedar trees, the presence of charcoal but absence of a fire site, and several unique, WinGate-associated types of litter (e.g., p-cord, tuna wrappers, etc.). At approximately 83% of the WinGate sites, researchers documented notable, visible impacts. Most of these indicators are "avoidable" forms of impact when campers apply low impact practices applicable to dispersed "pristine site" camping (Marion, 2014), which are largely advised in the low impact guidance contained in WinGate's official staff manual (WinGate, 2016). Finally, only 44% of the sampled WinGate sites were

occupied a single night, though it is likely that some were used in the years preceding 2014. Approximately 25% of the sites were assessed <9 months after use, 20% were assessed 9-21 months after use, and 39% were assessed 21-33 months after use. Based on these results, nearly 60% of the WinGate campsites should have recovered to near-natural conditions if impacts were kept at or below levels able to recover in a one-year period.

Results suggest that there is a disconnect between what is being taught and prescribed in the WinGate staff manual, and the practices taking place in the field. Strategies to ensure that field staff and participants follow the low impact camping practices included in the manual, along with a program of random field checks to ensure future accountability is merited. Findings indicate that a substantial amount of repeat use is occurring, which is creating lasting impacts that do not recover in a single year. For dispersed pristine site camping to avoid creating lasting resource impacts, we suggest that WinGate staff attempt to camp at each location only once a year, avoiding all spots that exhibit prior evidence of camping. Results indicate that this is not currently WinGate's practice.

We suggest that WinGate develop additional low impact policies that incorporate improved dispersed pristine site camping practices and established site camping practices that concentrate use on sustainable sites that receive repeat use. Recreation ecology research indicates that concentrating repeat use on a single site within each area will result in far less cumulative impact than would camping many times per year on a larger number of dispersed campsites (Marion 2016). Thus, the results of this project suggest that within each commonly used area, WinGate could identify a designated campsite for use whenever they are unable to move each night, and use only that site when repeated camping at one location is necessary. Guidance regarding these practices is described further in the Literature Review, and Discussion and Implications Sections, as well as Appendix C, found in this Phase 1 Report. Finally, in subsequent phases of this research project, we are available to collaborate with WinGate and/or GSENM staff in assisting to develop or review Leave No Trace-related practices for dissemination and implementation in the future.

Purpose of Study

The purpose of this study is to provide the continued inventory and monitoring of recreation impacts within the backcountry and dispersed areas throughout GSENM. The overarching objectives of this research are to monitor and record backcountry recreational use impacts, and utilize the data collected to identify critical issues and adapt monitoring protocols to aid the Bureau of Land Management (BLM) and GSENM in future planning and management decisions. This research project will span from 2016 to 2021, and will include five phases of

research, which will each contain a subset report. This report discusses the results from phase one of this study.

The ecological health of GSENM is vital to sustain the mission and ensure continued quality recreation opportunities in the Monument. This research, as a whole, will continue the development of indicators and monitoring associated with recreation-related impacts to natural resources in the backcountry of GSENM in a time when use and demands on the resource are increasing. The results of this research will inform visitor use management in a manner that aligns with GSENM management objectives and can be used to advise the sustainability and feasibility of diverse recreational opportunities while conserving the ecological, cultural, and paleontological resources of the area. Thus, this project will provide the vital information needed to ensure monitoring that can inform and enable management to sustain the unique resources present in GSENM, which is fundamental for quality recreational experiences.

This research project will span from 2016 to 2021, across five total data collection periods. The research team, administered through Pennsylvania State University, consists of Drs. Taff, Wimpey, and Marion. During the fall of 2016, these researchers performed phase one of this research project, collecting data in the southwest portion of GSENM. This phase focused on backcountry campsites that had previously been evaluated, as well as areas used by WinGate Wilderness Therapy Programs in 2014, 2015, and 2016, specifically in the southwestern portion of the Monument. Relevant background regarding GSENM, previous data collection efforts, and details regarding WinGate programming are described below.

Background

GSENM contains over 1,866,000 acres, which are managed by the Bureau of Land Management (BLM). GSENM is the first national monument to be managed by BLM and the last place in the continental U.S to be mapped. The area contains stunning landscapes, unique topography, and ecosystems containing natural, cultural, and paleontological resources that facilitate varied recreational and commercial opportunities. GSENM is situated within an area surrounded by protected areas that are managed by other federal entities, such as the U.S. Forest Service and National Park Service. The area contains numerous designated wilderness areas, and within GSENM specifically, the BLM manages sixteen wilderness study areas (WSAs), which require that management retain the wilderness character of the areas by maintaining

naturalness and outstanding opportunities for recreation (GSENM Management Plan, 2000). Recreational opportunities in GSENM include activities such as camping and backpacking, climbing and canyoneering, off-highway vehicle (OHV) use, hunting, fishing, stock use, and education and interpretation. Commercial entities are also allowed under permit, including livestock grazing and outfitter and guide operations.

Like many protected areas that are managing recreation opportunities while trying to conserve the unique ecosystems sought by recreationists, the managers at GSEMN must strike a balance between use and preservation of the resources (Grumbine, 1994). This is particularly challenging in an area like GSENM and southern Utah generally, where visitors may be local or international, participate in a variety of activities, and possibly recreate in numerous types of protected areas with varying levels of direct and indirect management. This challenge is confounded by increased use within the state of Utah, thought to be contributed to recent marketing strategies by the state (e.g., "The Mighty Five", "Utah – Life Elevated"). Inevitably, recreational use, and in particular increases in use and types of use, leads to resource impacts (Hammitt, Cole, & Monz, 2015). Specific to the Monument, research suggests that visitors to GSENM seek naturalness and tranquility in the remote and rugged landscape, which promotes self-reliance and discovery (Casey, 2014). However, these characteristics are in jeopardy, due to the increased use of the area and the associated impacts to the resources such as vandalism, trash, human waste, and crowding (Casey, 2014).

At a national and state level, the BLM has developed strategic plans to inform management approaches that mitigate ecological and social impacts on the National Conservation Lands System (NCLS). As part of this system, GSENM managers are charged with providing "sustainable recreation" opportunities, defined as those that "provide for environmental sustainability while fulfilling the social and economic needs of present and future generations" (NLCS 15-year Strategy (2010-2025): The Geography of Hope, 2011). The 15-year strategy, as prescribed in the BLM's "Geography of Hope," suggests that the agency must use science to aid in management in a manner that provides for compatible uses that protect the resources and values of GSENM; manage the area collaboratively, considering other agencies and land owners that influence the larger ecosystem in which the Monument is situated; and increase the public's awareness and understanding in a manner that promotes current and long-term stewardship (NLCS 15-year Strategy (2010-2025): The Geography of Hope, 2011). Specifically, the plan suggests that GSENM "develop measures and conduct management reviews" (Theme 1; Goal 1a) to evaluated effectiveness, by generating and maintaining "baseline inventory and geo-referenced data of NLCS values" (Theme 1; Goal 1b).

This strategy specifically suggests that the agency apply science to inform interpretive strategies and continue to support programs such as “Leave No Trace to foster outdoor ethics and stewardship” (Theme 3; Goal 3d).

Literature Review

Visitor impacts to protected natural areas, such as GSENM, provide an increasing challenge for land managers guided by mandates to achieve and maintain high quality resource conditions and visitor experiences. This section will review visitor use management objectives, decision-making frameworks, and implications from recreation ecology research regarding impact management strategies and low impact practices needed to sustain visitation while minimizing associated resource impacts. It includes extensive excerpts from a recent state-of-knowledge paper by Marion (2016).

As reviewed in Marion, Leung, Eagleston, and Burroughs (2016), recreation ecology studies have documented the types and severity of impacts occurring to vegetation, soils, wildlife, and water resources (see also Cole, 2004; Hammitt et al., 2015; Newsome et al., 2012; Monz et al., 2010). An understanding of these impacts and their areal extent, rates of change, and relationships to important causal and influential factors is critical to selecting and implementing effective management responses that avoid or minimize recreation-related resource impacts.

Carrying capacity has long provided the predominant framework for planning and management decision-making that addresses the protection of natural resource and social conditions (Manning, 2011). Over time, managers have shifted from a narrow focus on numeric carrying capacity to a broader decision-making process that incorporates a more comprehensive array of management strategies and actions (Graefe et al., 2011). Most recently, six U.S. federal agencies – the Bureau of Land Management, Forest Service, National Oceanic and Atmospheric Administration, National Park Service, U.S. Army Corps of Engineers, and U.S. Fish and Wildlife Service – formed an Interagency Visitor Use Management Council (IVUMC) to “increase awareness of and commitment to proactive, professional, and science-based visitor use management on federally-managed lands and waters” (http://visitorusemanagement.nps.gov/). They define “Visitor Use Management” as the “proactive and adaptive process for managing characteristics of visitor use and the natural and managerial setting using a variety of strategies and tools to achieve and maintain desired resource conditions and visitor experiences” (http://visitorusemanagement.nps.gov/). They emphasize that managing visitor access and use for recreational benefits and resource protection is inherently

complex, requiring consideration of natural and social science studies, management experience, and professional judgment.

We briefly describe the new IVUMC Visitor Use Management (VUM) planning and decision-making process and suggest it for consideration by GSENM staff, as a means for understanding, monitoring and adaptively managing visitor use and associated impacts. Our research work is designed to inform such processes by providing data on the nature and extent of existing camping-related resource impacts, identifying possible resource condition indicators and presenting data that can assist in setting thresholds for gauging when impacts reach unacceptable levels, developing field protocols for periodically monitoring impacts to compare current conditions to thresholds, and suggesting visitor impact management strategies to effectively minimize present and future camping impacts.

From Carrying Capacity to Visitor Use Management

Land managers operate under laws and administrative policies that direct them to achieve a "balance" between competing "recreation provision" and "resource protection" objectives. The traditional body of knowledge developed by managers and scientists to address the negative impacts of visitation to resource and social conditions was termed "carrying capacity." While the early management activity and literature focused on defining a numeric limit on visitor numbers below which resource and social conditions would be protected, several decades of management and research experience have demonstrated that amount of use is strongly correlated with the magnitude of resource impact only at low levels of use. Thus, limiting use is often an ineffective means for achieving resource protection objectives on moderate to high use trails and recreation sites, prompting the need to consider a diverse array of alternative considerations and actions (Leung and Marion, 2000; Manning, 2007; 2011; Wagar, 1964). This is widely accepted in the context of minimizing resource impacts, though court challenges based on dated laws specifying the role that numerical limits should play in carrying capacity planning continue to focus management attention on visitor numbers (see Graefe et al., 2011; Whittaker et al., 2011).

To illustrate the influence of other factors, consider a popular, well-used campsite that has lost nearly all of its vegetation cover. Due to the general asymptotic use/impact relationship (examined later) and strong influence of other factors, reducing use on a heavily used campsite by 20% is often unlikely to result in any meaningful improvement in site conditions. Recreation ecology studies reviewed in this paper reveal that other factors are generally more effective in

minimizing resource impacts. These factors include: 1) sustainable siting and design of campsites relative to topography, 2) actions that spatially concentrate activity to a limited "footprint" of disturbance, and 3) regulations and persuasive communication that promote low impact behaviors (Hammitt et al., 2015; Leung and Marion, 2000a; Marion, 2014). Similar findings have been identified for social impacts like crowding and conflict, such as the significant influence of visitor motives, use type, user behavior, and the location or timing of encounters (Manning, 2007; 2011).

An array of planning and decision-making frameworks have been developed to provide guidance for this expanded complexity (Manning, 2011). These frameworks are more broadly focused on managing visitor use to protect resources and provide high quality experiences, with numeric carrying capacity determinations included as an option when needed or required by law. The most widely applied frameworks are the U.S. Forest Service Limits of Acceptable Change (LAC) and the National Park Service's Visitor Experience and Resource Protection (VERP) frameworks (Stankey et al., 1985; National Park Service, 1997). Common attributes include prescriptive management objectives that define desired resource and social conditions, selection of indicators and thresholds (standards) of acceptable change, monitoring to compare current conditions to standards, and implementation and evaluation of corrective management actions. These frameworks have been incorporated into many federal protected area planning documents, though staffing and funding levels frequently challenge and even prevent managers from sustaining their effective use (Farrell and Marion, 2002; Manning, 2007).

More recently, the IVUMC has developed a VUM planning and decision-making framework to provide consistent guidance for federal land management agencies (Figure 1) (http://visitorusemanagement.nps.gov/). This framework is similar to and consistent with LAC and VERP but incorporates lessons learned from agency experience to address past planning and legal challenges (Graefe et al., 2011; Whittaker et al., 2011). For example, it contains a "sliding scale of analysis" in each step to match analytical investments with the level of complexity and risk associated with the issues being addressed. VUM incorporates additional guidance for carrying capacity decision-making when needed, but its primary focus is on visitor use management topics, including park development, transportation planning, and commercial uses. Implementation of VUM has already begun in several federal agencies.

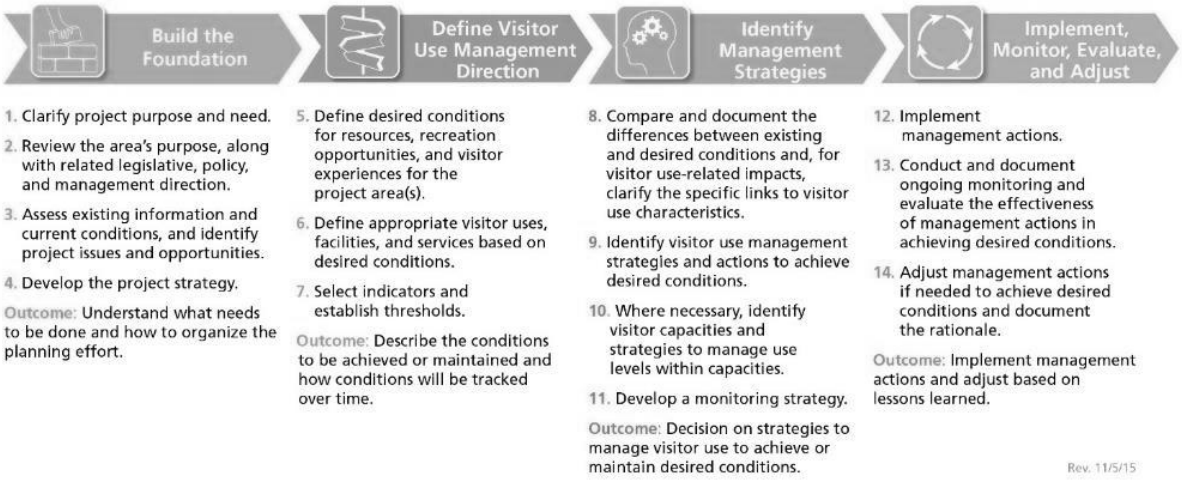


Figure 1. The Interagency Visitor Use Management Council has developed a Visitor Use Management framework for federal land management agencies that includes 4 core elements and 14 steps. Source: http://visitorusemanagement.nps.gov

Managing Visitor Impacts

A diverse array of visitor use management strategies and actions have been proposed to address visitor impact management problems (Hammitt et al., 2015; Hendee and Dawson, 2002). Cole et al. (1987) proposed eight categories of strategies and tactics with management guidance to address common wilderness management problems, reorganized into five core strategies in Table 1. Management interventions seek to avoid or minimize impacts by manipulating either use-related factors (e.g., amount or type of use and user behaviors) or environmental factors (e.g., environmental resistance and resilience related to vegetation or soil attributes, topography, etc.) (Hammitt et al., 2015; Pickering, 2010).

Table 1. Core management strategies and actions for avoiding or minimizing resource and social impacts in wildland settings

CORE STRATEGIES	MANAGEMENT ACTIONS
MANAGE USE LEVELS	Redistribute, discourage, or limit use (e.g., set access point or travel zone quotas).
	Redistribute or reduce use during times of peak use, in high use locations, or when impact potential is high.
MODIFY THE LOCATION OF USE	Concentrate use on sustainable expansion-resistant trails and campsites to limit the aggregate area of impact.

	Disperse use on durable substrates at levels that prevent formation of trails and campsites.
	Encourage or require visitors to camp out-of-sight or a minimum distance from trails and campsites.
	Restrict certain types of use to specific locations (e.g., restrict horses to trails and campsites designed for their use).
INCREASE RESOURCE RESISTANCE	Construct, reconstruct, or maintain impact-resistant trails and campsites (e.g., construct side-hill trails and campsites, install anchored campfire rings).
MODIFY VISITOR BEHAVIOR	Persuasive Communication, Interpretation or Education - encourage or require low impact practices when traveling and camping.
	Regulation and enforcement - prohibit or require certain practices and equipment when traveling and camping (e.g., feeding wildlife, safe food/trash storage, woods tools).
CLOSE AND REHABILITATE THE RESOURCE	Close and rehabilitate unnecessary or less sustainable trail segments and campsites.

(Adapted from Cole et al., 1987 and Marion, 2003)

In the following sections, we review the most relevant and recent recreation ecology literature that informs the selection of effective visitor impact management strategies and actions presented under the first two core strategies outlined in Table 1: Manage Use Levels and Modify the Location of Use (Marion, 2016). These strategies have the greatest relevance to this study of WinGate camping impacts within GSENM.

Selecting and implementing an effective management action to avoid or minimize visitor impacts requires knowledge and consideration of: 1) the underlying causes and influential factors affecting the impacts, and 2) careful consideration of a range of alternative actions to evaluate their potential effectiveness and impact on visitor experiences. The following sections review recent research and case studies that have effectively applied recreation ecology knowledge to reduce visitor impacts. As will be revealed, effective management actions target the most influential factors, account for causal and contextual factors, and often employ more than one strategy or action.

The Visitor Impact Management Toolbox: Manage Use Levels

As described in Marion et al. (2016), most forest types have ground vegetation that is neither resistant nor resilient to trampling; even open meadow vegetation with resistant grasses and sedges cannot sustain more than a week or two of camping or about 150 passes along a new informal (visitor-created) trail. As depicted in Figure 2, above a relatively low threshold of trampling pressure, impacts occur rapidly as plants and organic litter are trampled and lost. This is followed by the exposure and loss of organic soil and compaction of underlying mineral soil. Once the majority of vegetation and litter cover has been lost, soil compaction occurs quickly and further increases in visitation, which results in diminishing amounts of vegetation and soil impact. Trail, campsite, and experimental trampling studies have consistently documented this nonlinear asymptotic use-impact relationship between amount of recreational trampling and most types of vegetation and soil impacts (Cole, 1995; Hammitt et al., 2015; Monz et al., 2010). This asymptotic use-impact relationship has also been consistently documented in other countries with diverse vegetation and soil types (Barros and Pickering, 2015; Hill and Pickering, 2009; Littlemore and Barker, 2001; Newsome et al., 2013; Pickering et al., 2010; Roovers et al., 2004; Whinam and Chilcott, 2003).

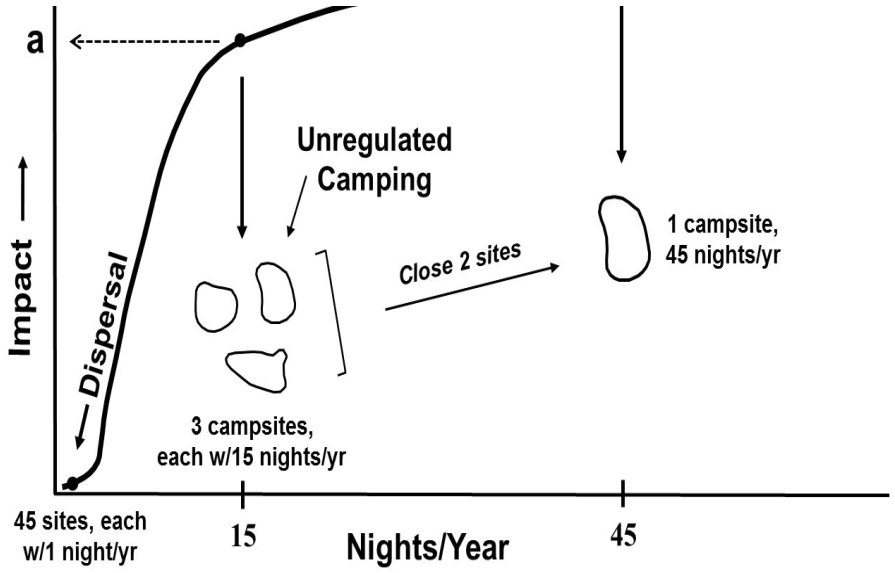


Figure 2. A generalized model of the use-impact relationship for trampling on vegetation and soil illustrating when use-reduction is and is not effective and the empirical basis for effective dispersal and containment strategies

The implications of this asymptotic use-impact relationship are that reducing use on well-established moderate- to high-use trails and recreation sites are unlikely to appreciably diminish vegetation and soil impacts; it is an ineffective strategy unless substantial reductions occur (Figure 2). In contrast, limiting use within the low-use zone, where impacts occur rapidly, can lead to substantial reductions in vegetation and soil impact. However, this zone occurs at relatively low levels of traffic, generally between 3 and 15 nights of camping per year, or 50 to 250 passes per year along a trail (Leung and Marion, 2000; Cole, 1995).

Modify the Location of Use

What happens when recreational activities are unmanaged in protected natural areas? Studies reveal that unmanaged visitation frequently results in considerably greater recreational impact. For example, informal (visitor-created) trails have design attributes that make them less sustainable than professionally designed formal trails (Wimpey and Marion, 2011). Similarly, visitors frequently create campsites in large, flat areas with fragile, herbaceous vegetation along the banks of streams. Site expansion and proliferation are common in such areas, which leads to excessive resource impacts and problems with visitor crowding and conflict (Cole, 1993; Leung and Marion, 2000; Reid and Marion, 2004).

A manager's ability to manipulate the location of visitor activity is one of the most powerful strategies in the visitor impact management toolbox (Leung and Marion, 1999). Managers can attempt to contain use on a sustainable infrastructure of trails, campsites, and recreation sites, focus intensive traffic on the most durable artificial or natural substrates, separate visitors to promote solitude or prevent conflicts, or disperse use to levels that avoid lasting impact (Hendee and Dawson, 2002; Manning and Anderson, 2012).

Dispersed "Pristine Site" Camping Strategy

The core objective of a dispersal strategy is to reduce traffic to levels that prevent formation of resource impacts lasting more than a year (Cole and Monz, 2003; 2004); this level of dispersal may also effectively resolve problems with visitor crowding and conflict. Successful dispersed camping requires visitors to apply "pristine site" camping practices (Figure 3), which are facilitated by camping in areas with little ground vegetation or on resistant and resilient dry grasses or using low impact equipment (Marion, 2014). Few managers have had success with a

dispersal strategy due to: 1) limitations on the number of available camping areas with resistant vegetation and/or durable substrates and 2) an inability to effectively influence visitor behavior thru education or regulation related to the strategy and associated "pristine site" camping practices. However, this strategy has been somewhat effectively applied in some remote low-use protected areas, particularly in Alaska (Marion and Wimpey, 2011).

GSENM has implemented a dispersal strategy for use by the WinGate Wilderness Therapy program, and this provides an excellent opportunity to evaluate its efficacy. An effectively implemented "pristine site" program would result in our finding relatively few visually obvious campsites when we travel out to the WinGate camping locations during our field surveys.

Figure 3. Successful dispersed camping is challenging to implement and requires visitors to learn and apply "pristine-site" camping practices.

Containment (Concentration) Strategy

For protected areas with moderate to high visitation, a containment and concentration strategy is preferred and has been effectively applied (Leung and Marion, 1999). The core objective of a concentration strategy is to contain camping impact to the smallest number of sites needed and to spatially concentrate camping activity on each site to minimize the total or aggregate area of camping disturbance (Cole, 1992; Hammitt et al., 2015; Leung and Marion, 2004). As shown in Figure 3, managers could close two campsites and shift use to the third, preferably a site with durable substrates and limited expansion potential. Due to the curvilinear use-impact relationship, impact on this third site would increase only marginally, from "a" to "b," and aggregate impact would decline substantially, from three sites with an "a" level of impact to one site with a "b" level of impact (Figure 2). Effective application of this strategy requires campsite designation and/or development coupled with education and/or regulations directing visitors to camp only on designated or well-established campsites and to spatially concentrate their activities within core areas. Problems with crowding and conflict may be resolved by design and development of campsites and their proximity to other sites, attractions, and trails (Manning and Anderson, 2012).

A containment strategy minimizes aggregate impact by restricting camping to a small number of designated expansion-resistant campsites, with greatest effect achieved through a reservation system that links groups to specific campsites to achieve high occupancy rates. Unfortunately, reservation systems force visitors to adopt a rigid itinerary that may be difficult to keep and which substantially limits freedom and spontaneity (Stewart, 1989). Less rigid containment options require or ask visitors to use any available designated or "well-established" campsite, which allows managers to close and restore unnecessary and/or less sustainable sites (Cole and Benedict, 1983; Reid and Marion, 2004). To avoid the "musical chairs" dilemma of too many groups for available site numbers, managers must: 1) match the number and distribution of campsites with camping demand or 2) manipulate entry point or travel zone quotas to match demand with supply. While reservation systems can achieve exceptionally high campsite occupancy rates, designated or established-site camping without reservations can still reduce aggregate camping impact by targeting occupancy rates in the 50-80% range. These less rigid camping management options trade-off the benefits of increased visitor freedom against the resource protection "cost" of retaining a larger inventory of campsites with greater aggregate impact.

Another important and relevant recreation ecology research finding is that resource impacts occur rapidly on new trails and campsites, but recovery rates are substantially slower (Cole, 2013; Leung and Marion, 2000; Hammitt et al., 2015). At Delaware Water Gap National Recreation Area, experimental trampling and longitudinal campsite research found stable

conditions with little annual change on well-established campsites over a five-year period, but substantial resource changes on new campsites, primarily occurring during their first year of use (Marion and Cole, 1996). By year three, resource conditions on the new campsites resembled those on well-established campsites. In contrast, campsites closed to use recovered at much slower annual rates and after six years the floristic composition of vegetation still differed from adjacent undisturbed areas, in spite of more favorable recovery conditions and rates than reported in most other recovery studies.

The principal implications of these findings are that: 1) aggregate camping impact is optimally minimized by containing camping activity to a small number of well-used, expansion-resistant campsites, and 2) temporary closure and rest-rotation schemes are ineffective because impact rates far exceed recovery rates.

At Shenandoah National Park, managers converted an ineffective dispersed camping strategy to a containment strategy by closing and rehabilitating large numbers of wilderness campsites (Reid and Marion, 2004). A core factor in selecting the campsites that would remain open was their expansion potential related to topography, rockiness, and dense woody vegetation. Within three areas selected for study at Shenandoah, 73 campsites with an aggregate disturbed area of 22,842 ft^2 were reduced to 37 campsites with a disturbed area of 11,292 ft^2. Campsite numbers were reduced by 49%, aggregate area of disturbance by 50%, and mean size by 3%, despite an estimated 53% increase in campsite visitation (from 19 to 29 nights/yr). Campsite occupancy rates increased from 16% to 50%. These results substantiate Cole's (1992) theoretical campsite impact model.

Finally, managers may find that combined strategies can offer substantial flexibility in balancing resource protection and recreation provision objectives. For example, managers might prohibit camping in sensitive cultural and natural resource areas, employ designated site camping in moderate-use areas, and enact reserved site camping at the most popular destinations. For example, Cole and Fitchler (1983) presented results from campsite studies in three western wilderness areas, concluding that impacts are best minimized by limiting use to a small number of sustainable and professionally managed sites, with dispersed pristine site camping reserved for remote low-use areas.

GSENM Containment (Concentration) Strategy

At GSENM, the containment (concentration) strategy is employed along backcountry roads where vehicle-accessed campsites receive repeated use, though these campsites are not

"formally" designated. These campsites appear to have been originally visitor-created and not specifically selected by managers based on their resistance to expansion or presence of durable substrates. A sample of these campsites were also investigated. This will allow us to evaluate their resource conditions and include guidance on actions to limit future impacts.

GSEMN managers must develop indicators that can be monitored over time, so that visitor use can be balanced in a manner that conserves the valuable resources at the Monument. For phase one, impacts related to visitor use in GSENM focused on two areas in the southwest portion of the Monument, including: previously evaluated backcountry campsites (PEBCs), and campsites used by the WinGate Wilderness Therapy Program (WinGate).

Previously Evaluated Backcountry Campsites

Prior to the research described in this report, backcountry campsites impacts were collected in GSENM by researchers using paper forms. The impacts were assessed through an expansive list of potential indicators and evaluated largely through categorical assessments. Thus, the paper format and categorical nature of these data made accessibility, analyses, and continued monitoring strategies to evaluate impact and use trends rather difficult. New technologies, including digital data collection and global positioning systems (GPS) have become readily available and can enable streamlined monitoring of backcountry campsite indicators. When developed collaboratively with the managing agency that will use monitoring data to adaptively manage a given protected area, indicators that are feasible and repeatable to measure can be developed. Furthermore, by employing digital data collection measures with metrics that allow for easy access and data analysis over time, managers can better evaluate trends in use and make informed decisions that preserve both social and ecological resources.

WinGate Wilderness Therapy Program Campsites

Within GSENM, WinGate is a permitted commercial entity that predominately uses the southwestern portion of the Monument to provide participants with guided and facilitated nature-based therapy opportunities year-round. WinGate provides therapy for youth and adults who struggle with psychological ailments and/or substance abuse issues (https://www.WinGatewildernesstherapy.com, n.d.). Wilderness-based therapies, such as those offered by WinGate, have been linked to improved human health and wellbeing (see Cooley, 1998; Davis-Berman & Berman, 2008; Gass, Gillis, & Russell, 2012; Hoag, Massey, Roberts, & Logan, 2013; Lariviere et al., 2012; Norton et al., 2014; Russell & Hendee, 2000; Tucker, Norton, DeMille, & Hobson, 2016). During this type of therapy, participants learn the

skills needed to travel and live in the wilderness through extended periods of time spent in the outdoors (Tucker et al., 2016), during which they backpack and camp across the landscape. The average length of time that a participant remains in a wilderness therapy program depends on the organization, however, most organizations report the average length of stay as between six to ten weeks (see examples from organizations such as BlueFire - http://www.bluefirewilderness.com; Journey - http://journeywilderness.com; New Vision - http://newvisionwilderness.com; Redcliff Ascent - http://www.redcliffascent.com). Similarly, depending upon the specific program, WinGate participants engage in nature-based, guided and facilitated therapy in GSENM and some surrounding, protected areas for several weeks, moving in small groups to different backcountry camping locations every day or every few days. Therefore, WinGate participants spend an extensive amount of time over a large expanse of GSENM. However, there is a lack of research that has explored what environmental impacts exist as a result of wilderness therapy programs like WinGate, which specific practices cause these impacts, and what might be done in the future to mitigate these impacts on the resources (Russell & Hendee, 2000). WinGate does provide extensive training to staff, and has specific outdoor ethics practices that they recommend (see Table 44 and Appendix B for description of practices), but there is little to no understanding of the impacts this commercial operation may have on the ecological resources of the MMonument. Furthermore, Russell and Hendee (2000) suggest that “Enhanced communication and cooperation is needed between agency managers and wilderness therapy leaders to coordinate use and address impacts” (p. 141).

Given the limitations of the backcountry inventory and monitoring data that was previously collected in GSENM, and the largely undocumented use of the Monument by WinGate, in phase one of this study, the researchers collaboratively developed an inventory protocol and sampling strategy with Monument staff to collect recreation-related impact data in the southwest portion of the Monument. Data collection focused on revisiting sites that had been previously evaluated and monitored, as well as backcountry sites that had been used by WinGate during 2014, 2015, and 2016. The following section describes the methodological approaches used in this effort.

Phase One: Technical Approach

This research project began with collaboratively determining sampling locations in coordination with GSENM staff through multiple conference calls and a kick-off meeting in

September of 2016. Prior to the meeting, the researchers used previous data, including the indicators collected from campsite monitoring in the past, and SPOT data points (i.e., GPS enabled data points sent from WinGate over the span of specific periods of time in 2014, 2015, and 2016, to help inform sampling design.

Ultimately, a Fulcrum software-based "data dictionary," containing specific indicators and descriptions of how data should be collected in the future, was developed using an online platform that enables digital data collection and analyses (Appendix A). The data dictionary was derived from previous campsite inventory and monitoring efforts, but was modified to accommodate comparison to previous monitoring protocols employed on the monument, to address the local desert environments, and to allow for inventory of "pristine" site camping practiced by WinGate and others on the monument. Field trials of initial data dictionaries and protocols were accomplished with BLM staff, including managers and rangers who provided significant and valued input that efficiently shaped the survey methods to meet managers' needs and local conditions present in the study area.

Field work was conducted from September 15-29th, 2016, with the bulk of the collection focused on the western portion of the monument, bounced by Highway 89; the town of Kanab; Johnson Canyon Road; Skutumpah Road; and the Paria Wash (see Figures 4 and 5). GPS based SPOT data utilized by WinGate staff were used to identify locations where overnight use had occurred in the previous 3 years (2014-2016). GIS analysis of the SPOT data generated maps showing overnight use by year by using a combination of selection techniques to filter the data that met the following criteria:

- SPOT data within the boundary of the Monument
- Transmissions that were sent between midnight and 6AM (local time)

See Figure 4 and Table 2 for the location of these data. These data include 3,151 data points within the study area.

Table 2. Three Year Distribution of SPOT Night Data within GSENM

SPOT Data Night Records within GSENM (2014-2016)	
Year	Count (%)
2014	988 (31%)
2015	1408 (45%)
2016*	755 (24%)

*partial data set through June 21, 2016

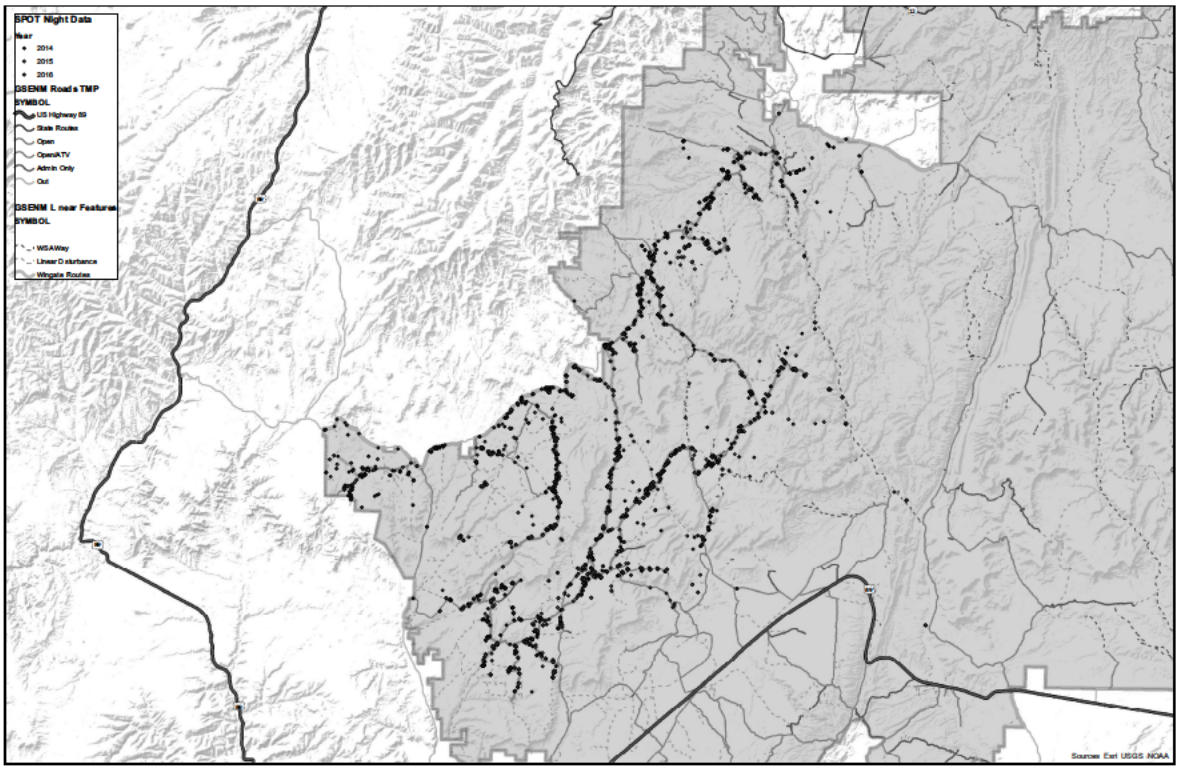


Figure 4. Three Year Distribution of SPOT Night Data within GSENM

Maps showing the locations of the SPOT Night Records were loaded onto GPS units for navigation in the field for collection of campsite conditions and attributes using the Fulcrum-based data forms. In addition to the SPOT data, previously monitored campsite locations (collected by NAU from 2004-2014) were mapped for recollection for continued monitoring. Due to the dispersed nature of these campsites, and the size of the study area, field efforts initially targeted dense clusters of campsites along Skutumpah, Timber Mountain, Nephi Pasture, and Nipple Lake Roads. Subsequent data collection focused on sites that were dispersed on the landscape and had single SPOT locations associated with them. In total, 239 sites were collected during the 2016 field session, with 86% of these sites representing WinGate utilized sites, 23 previously monitored campsites, and 10 road side campsites not previously identified or monitored (see inventory map).

Results

All Campsites

The results are presented by overall sample, including both reassessments of the previously evaluated campsites and inventories of the WinGate campsites, followed by descriptive details regarding only the WinGate campsites that were evaluated (Table 3; Figure 5).

The majority of the campsites inventoried during Phase one, were WinGate campsites (~86%; n=206). Thirty-three additional non-WinGate sites were evaluated as well, 23 of which were previously inventoried.

Table 3. Overall Sample of Campsites

Campsite Type	Frequency	Percent
WinGate	206	86.2
Other (Non-WinGate Sites)	33/(23 of which were previously evaluated sites)	13.8
Total	239	100

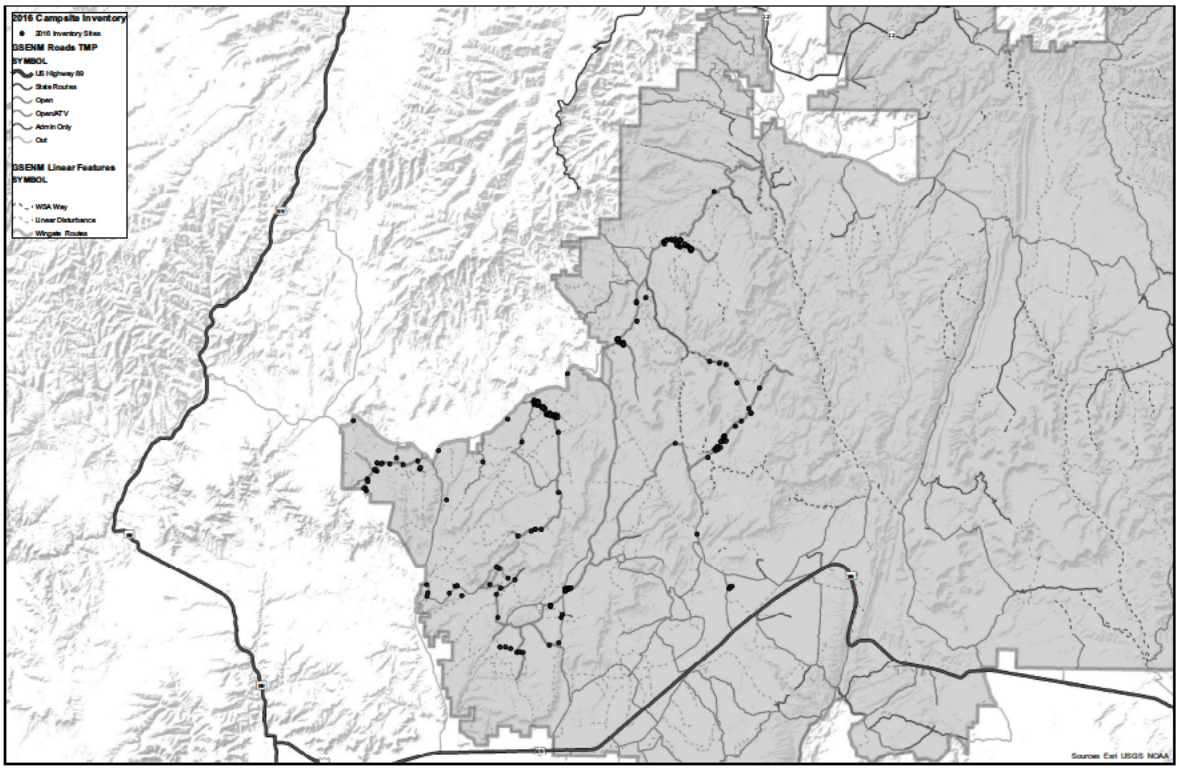


Figure 5. Overall Sample of Campsites.

The majority (86%; n=206) of campsites evaluated were considered to have low impact levels. Thus, impacts were not readily obvious without extensively investigating the area (Table 4; Figure 6). Twenty-seven, or approximately 11% of the campsites examined in this area of GSENM, were considered to have moderate impact. In these sites, it would have been obvious to the general visitor that the area had been camped in recently. For example, some evidence of fire/charcoal, micro-trash, broken branches, or collected firewood may have been present. Only six (~2.5%) of the campsites examined were considered to have heavy impact levels. It was apparent that these sites had received heavy amounts of use. In these sites, litter, tree damage, evidence of fire, and anthropogenic structures were common.

Table 4. Impact Level Across all Campsites Assessed

Campsite Impact Level	Frequency	Percent
Low	206	86.2

Moderate	27	11.3
Heavy	6	2.5
Total	239	100

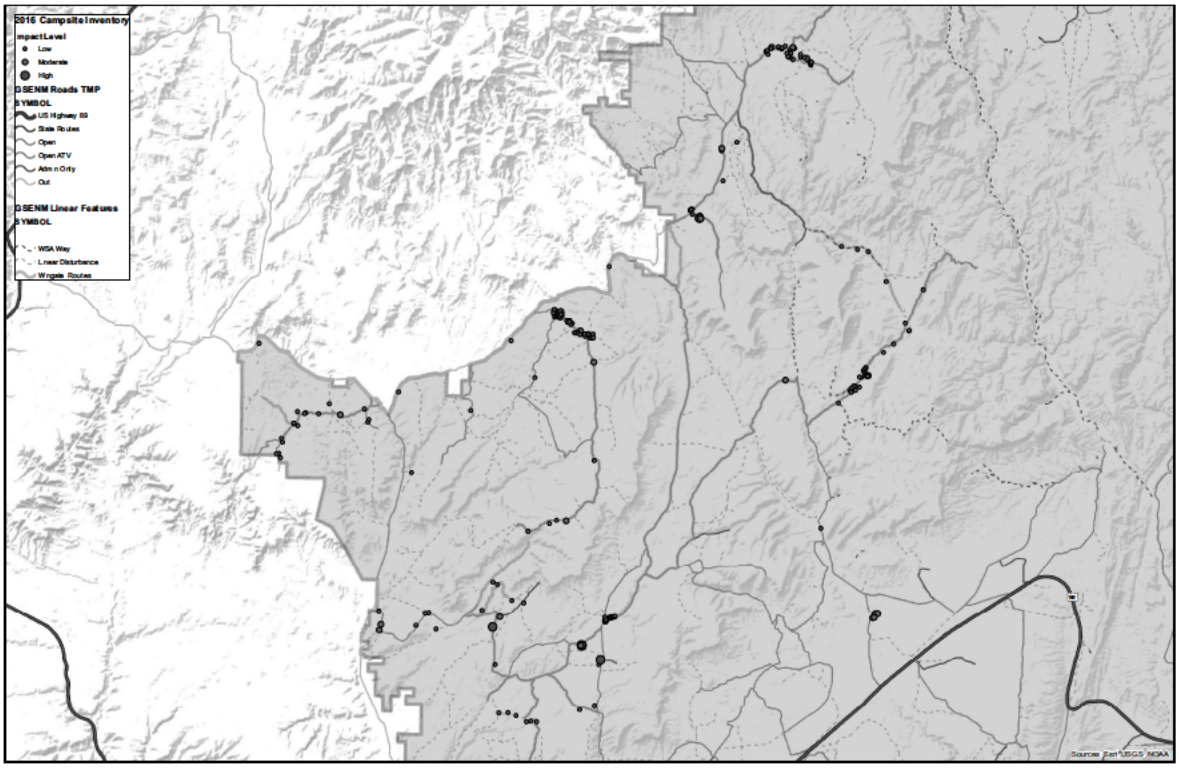


Figure 6. Impact Level Across all Campsites Assessed

Twenty-seven (11.3%) of the campsites evaluated had discernable campsite boundaries (i.e., researchers could easily determine the extent and associated boundaries of the campsites) (Table 5; Figure 7). These campsite evaluations can be compared to the previously collected data on these sites and monitored over time to assess changes and explore the effectiveness of adaptive management strategies.

The majority of campsites evaluated (~57%; n=137) had no discernable boundary, but did have some level of visitor impact, or traces, such as evidence of fires, litter, collected

firewood, tree or shrub damage, dug holes, human waste, visitor trails, or disturbed cryptobiotic crust. Two of the 137 campsites with no discernable boundary, but some level of impact, were not WinGate sites, but rather campsites used by the general public and reassessed during this study. Of the remaining sites examined, approximately 31% (n=75) were WinGate campsites with no discernable boundary or trace of visitor impact. Thus, the researchers searched the areas of interest based on the methods applied to this study, yet could not locate any trace of visitor impact at these previously used campsites.

Table 5. Discernable Campsite Boundaries Across all Campsites Assessed

Campsite Boundary Discernable	Frequency	Percent
Yes	27	11.3
No (But Some Visitor Impact Discovered)	137	57.3
No Impact Traces Discovered (WinGate Only)	75	31.4
Total	239	100

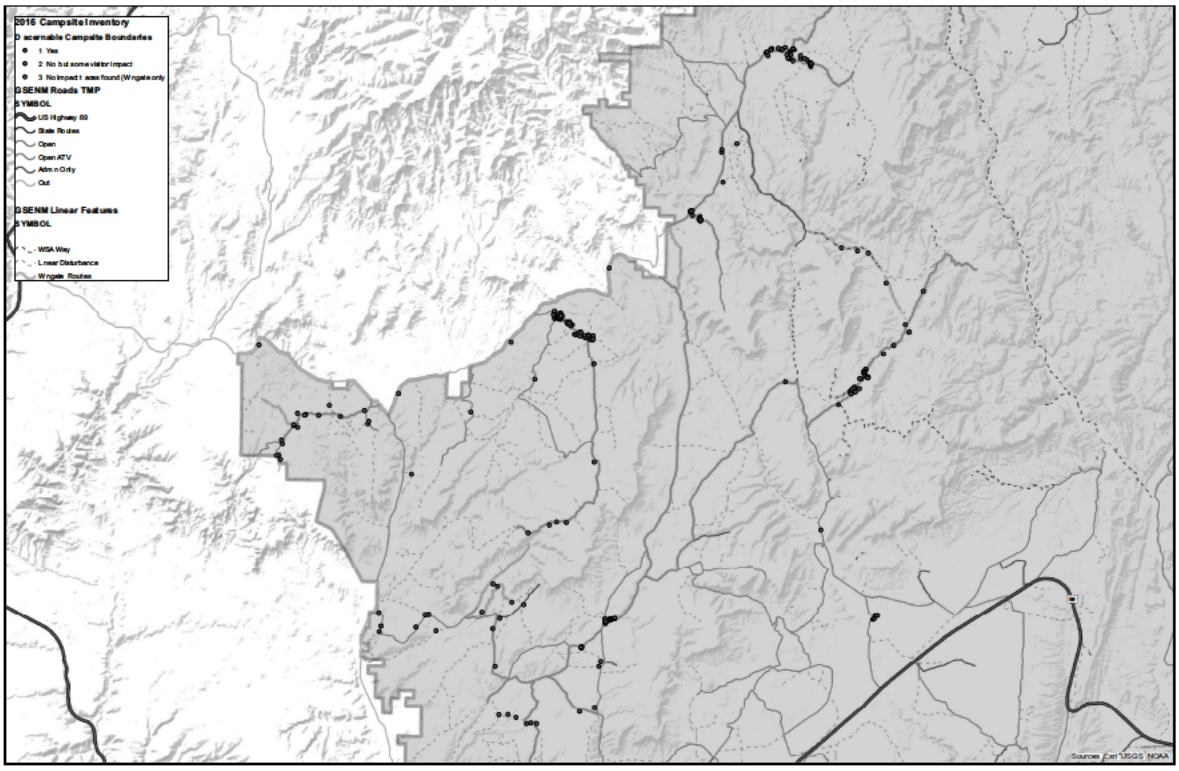


Figure 7. Discernable Campsite Boundaries

Previously Evaluated Backcountry Campsites (Non-WinGate)

The majority (~55%; n=18) of previously evaluated backcountry campsites (PEBCs) were considered to have low levels of visitor impact (Table 6). Approximately 42% (n=14) had moderate impact, and one site was rated as having heavy impact.

Table 6. Impact Level Across all Campsites Assessed

Campsite Impact Level	Frequency	Percent
Low	18	54.5
Moderate	14	42.4
Heavy	1	3

Total	33	100

Nine (~27%) of the PEBCs had access via vehicle (Table 7).

Table 7. Vehicle Access

Vehicle Access	Frequency	Percent
Yes	9	27.3
No	24	72.7
Total	33	100

The majority of PEBCs (~67%), were located in areas that had 75-100% potential for site expansion, given the landscape features surrounding the site (Table 8).

Table 8. Percentage for Potential Campsite Expansion

% for Potential Site Expansion	Frequency	Percent
25	1	3.7
30	1	3.7
40	4	14.8
50	2	7.4
70	1	3.7
75	1	3.7
90	8	29.6
100	9	33.3
Total	33	100

At the majority (~85%; n=28) of PEBCs, obvious use areas, such as areas where it was clear that campers had slept or cooked, were noted (Table 9).

Table 9. Obvious Use Area (e.g., Sleeping or Cooking)

Obvious Use Area	Frequency	Percent
Yes	28	84.8
No	5	15.2
Total	33	100

The majority (~82; n=27) of PEBCs did have evidence of a fire (Table 9). Fire sites were marked by blackened rocks, charcoal, or ashes. These did not include locations where charcoal or ashes had been scattered (see Table 10).

Table 10. Fire Site

Fire Site	Frequency	Percent
Yes	27	81.8
No	6	18.2
Total	33	100

Visible ashes were a clear indication of evidence of a previous campfire. At the majority (~82%; n=27) of the campsites, the researchers discovered ashes or charcoal (Table 11).

Table 11. Ashes or Charcoal from Campfire

Ashes or Charcoal	Frequency	Percent
Yes	27	81.8
No	6	18.2
Total	33	100

Liter was one of the most common elements visible at the majority of the PEBCs (Table 12). At ~70% (n=23) of the campsites, litter was visible. Litter commonly included cans, food wrappers, and old “cowboy trash”.

Table 12. Litter Present

Litter Present	Frequency	Percent
Yes	23	69.7
No	10	30.3
Total	33	100

At ~46% (n=15) of the PEBCs, researchers noted firewood that had been collected (Table 13).

Table 13. Collected Firewood

Collected Firewood	Frequency	Percent
Yes	15	45.5
No	18	54.5
Total	33	100

At ~42% (n=14) of the campsites, researchers discovered tree and/or shrub damage (Table 14). Tree and shrub damage included visible impacts, such as cut branches, stumps, and bark stripping, as evidenced by Table 14.

Table 14. Tree or Shrub Damage

Tree or Shrub Damage	Frequency	Percent
Yes	14	42.4
No	19	57.6

Total	33	100

Researchers discovered bark stripping at only 2 (~6%) of the campsites that were PEBCs (Table 15).

Table 15. Bark Stripping

Bark Stripping	Frequency	Percent
Yes	2	6.1
No	31	93.9
Total	33	100

At five (~15%) of the PEBCs, researchers found dug holes (Table 16).

Table 16. Holes Dug-up

Holes	Frequency	Percent
Yes	5	15.2
No	31	93.9
Total	33	100

At ~12% (n=4) of the PEBCs, researchers discovered human waste (Table 17). Waste was often marked by toilet paper (and holes that had been unearthed, which was also noted in Tables 12 & 16).

Table 17. Improperly Disposed Human Waste

Human Waste	Frequency	Percent
Yes	4	12.1
No	29	87.9

Total	33	100

Visible trails were evident to and from the majority (~76%; n=25) of PEBCs (Table 18).

Table 18. Visible Visitor Trails

Visible Visitor Trails	Frequency	Percent
Yes*	25	75.8
No	8	24.2
Total	33	100

**Sites with impacts from cattle may have hidden some of the anthropogenic-caused trails.*

Approximately 28% (n=9) of the PEBCs contained trampled cryptobiotic soils and crusts around the campsites (Table 19).

Table 19. Disturbed Cryptobiotic Crusts in and around Campsite

Disturbed Cryptobiotic Crusts	Frequency	Percent
Yes	9	27.3
No	24	72.7
Total	33	100

The majority of PEBCs (~63%; n=17) had no presence of stumps (Table 20).

Table 20. Number of Tree Stumps (Count)

Number of Tree Stumps	Frequency	Percent
0	17	63
1	4	14.8

2	3	11.1
3	1	3.7
7	1	3.7
18	1	3.7
Total	33	100

The majority (~70%; n=23) of PEBCs contained one or two fire sites (Table 21), and ~15% contained evidence of three to four fires in a single campsite.

Table 21. Number of Fire Sites (Count)

Number of Fire Sites	Frequency	Percent
0	5	15.2
1	15	45.5
2	8	24.2
3	2	6.1
4	3	9.1
Total	33	100

The majority (~79%; n=26) of PEBCs had no evidence of campsite furniture (Table 22). However, ~22% (n=7) of the PEBCs did contain some form of furniture that had been developed at the site, such as logs or rocks moved for seating or external materials (e.g., metal fire rings, wooden tables, etc.) that had been brought in and left at the site.

Table 22. Campsite Furniture Level

Level of Campsite Present	Frequency	Percent

None	26	78.8
Some	7	21.2
Total	33	100

Approximately 55% (n=18) of the PEBCs had either one or two visible access trails that were largely motor vehicle-accessible (Table 23). Approximately 18% (n=6) contained 3 access trails, and two sites contained four access trails. One campsite had seven access trails to the single site. Approximately 18% (n=6) had no visible access trails to the sites.

Table 23. Visible Access Trails To/From Campsite

Access Trails	Frequency	Percent
None	6	18.2
1	10	30.3
2	8	24.2
3	6	18.2
4	2	6.1
7	1	3
Total	33	100

At the majority of PEBCs, (88%; n=29), there was no evidence of human waste (Table 24). However, three of the campsites contained one count, while one other site contained two counts.

Table 24. Frequency (Count) of Human Waste Seen at a Single Campsite

Human Waste Count	Frequency	Percent
None	29	87.9

1	3	9.1
2	1	3
Total	33	100

At the majority of PEBCs, (52%; n=17) there was no evidence of litter (Table 25). At seven of the campsites, litter was discovered in amounts that could be removed in a single hand. At nine of the remaining sites (27%), litter estimates ranged from quart bag to 5-gallon bag amounts.

Table 25. Litter Estimate at Campsite

Litter Estimate	Frequency	Percent
None	17	51.5
Micro-trash (.2x.2x.2 in.)	3	9.1
Hand-full (2x2x2 in.)	4	12.1
Quart bag	3	9.1
Gallon bag	3	9.1
5-Gallon bag	3	9.1
Total	33	100

WinGate Wilderness Therapy Program Campsites

The remaining portion of the results focus on WinGate campsites with no discernable campsite boundaries but some levels of visitor impact present.

A large percentage of WinGate campsites evaluated, (n=53; ~39%) were used in 2014 (Table 26). Approximately 25% (n=34) of all WinGate sites examined were occupied 2016, while ~20% (n=27) were occupied in 2015. However, it should be noted that the research took place in September of 2016, thus, there were three more months of use that were not accounted for

in this study. Several sites were occupied during multiple years. Interestingly, WinGate occasionally uses the same sites in back to back years. For example, several of the same sites were occupied in 2014 and 2015 (n=13; ~10%). Four sites (3%) sampled were used during all three years assessed.

Table 26. WinGate Year Camped in Site

WinGate Year Used	Frequency	Percent
2014	53	39.3
2015	27	20
2016	34	25.2
2014 and 2015	13	9.6
Used in 2015 and 2016	2	1.5
Used in 2014, 2015, and 2016	4	3
Unknown year used*	2	1.5
Total	135	100

**There were some inaccuracies in the SPOT data, and frequent overlap in clustered campsites within a small spatial scope, limiting exact determination for some sites.*

Sixty (44.4%) of the 135 campsites used by WinGate that were evaluated in this sample were occupied only one night (Table 27). However, for many of the sites, WinGate groups occupied the campsites for multiple nights. For example, ~26% of the sites (n=36) were occupied two nights, ~11% (n=15) were occupied three nights, ~9% (n=12) were occupied 4 nights, and ~6% (n=8) were occupied 5 nights.

Table 27. Frequency of Nights Site Used by WinGate across 2014, 2015, and 2016

Frequency of Nights Used	Frequency	Percent
1	60	44.4
2	36	26.7

3	15	11.1
4	12	8.9
5	8	5.9
7	1	.7
Unknown*	3	2.2
Total	135	100

**There were some inaccuracies in the SPOT data, and frequent overlap in clustered campsites within a small spatial scope, limiting exact determination for some sites.*

The remaining portion of the results focus on WinGate campsites with largely avoidable, and thus manageable, impacts. The following are campsites that were evaluated as having no discernable boundary, but there were obvious and avoidable visitor impacts present.

For the majority (83%; n=112) of the WinGate campsites, it was obvious that the site had been used, as evident by impact traces that were discovered by the researchers (Table 28). Impacts may have included evidence of trenching, ceremonial or decorative construction with natural objects, and broken branches where participants likely slept or cooked.

Table 28. Obvious Use Area (e.g., Sleeping or Cooking)

Obvious Use Area	Frequency	Percent
Yes	112	83
No	23	17
Total	135	100

The majority (~68%; n=92) of WinGate campsites did not have evidence of a fire (Table 29). Forty-three (~32%) of the campsites had visible evidence of fire upon examination by the researchers (Table 8). Fire sites were marked by blackened rocks, charcoal, or ashes. These did not include locations where charcoal or ashes had been scattered (Table 11).

Table 29. Evidence of a Fire Site

Fire Site	Frequency	Percent
Yes	43	31.9
No	92	68.1
Total	135	100

Visible ashes were a clear indication of a previous WinGate campfire. At the majority (57%) of the campsites, the researchers did not discover ashes or charcoal (Table 30). However, a substantial amount of WinGate sites (43%; n=58) contained ashes and charcoal.

Table 30. Evidence of Ashes or Charcoal from Campfire

Ashes or Charcoal	Frequency	Percent
Yes	58	43
No	77	57
Total	135	100

Liter was one of the most common elements visible at the majority of the WinGate campsites (Table 31; Figure 8). At ~86% of the campsites, litter was visible. Litter commonly included cord, food wrappers, feminine hygiene products, burnt or well-used cooking sets, and apparel such as socks or gloves.

Table 31. Litter Present

Litter Present	Frequency	Percent
Yes	116	85.9
No	19	14.1
Total	135	100

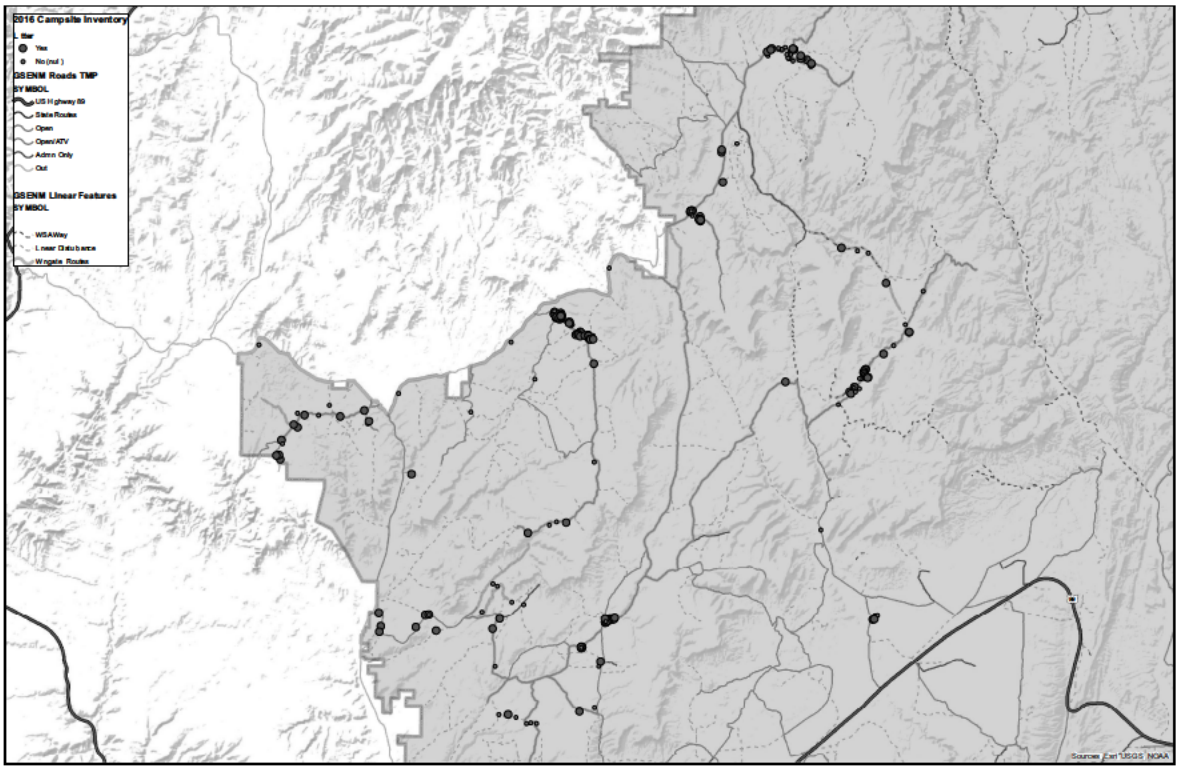


Figure 8. Litter Present

At ~26% (n=35) of the campsites, researchers noted firewood that had been collected by WinGate groups (Table 32). At these sites, it was common to see downed wood collected in piles.

Table 32. Collected Firewood

Collected Firewood	Frequency	Percent
Yes	35	25.9
No	100	74.1
Total	135	100

At ~28% of the campsites, researchers discovered tree and/or shrub damage (Table 33). Tree and shrub damage included visible impacts, such as cut branches, stumps, and bark stripping, as evidenced by Table 34.

Table 33. Tree or Shrub Damage

Tree or Shrub Damage	Frequency	Percent
Yes	38	28.1
No	97	71.9
Total	135	100

At ~33 percent of the WinGate campsites, the researchers noted evidence of bark stripping (Table 34). Bark stripping is likely a common practice to acquire fire-starting materials, and it was a common occurrence for approximately one-third of the campsites evaluated.

Table 34. Bark Stripping

Bark Stripping	Frequency	Percent
Yes	45	33.3
No	90	66.7
Total	135	100

At nearly half of the WinGate campsites examined (~50%; n=67), researchers found dug holes (Table 35). These holes were likely sites where human waste or food was buried by WinGate groups and dug up by GSENM wildlife.

Table 35. Dug Holes

Holes	Frequency	Percent
Yes	67	49.6
No	68	50.4
Total	135	100

At ~20% (n=27) of WinGate campsites, researchers discovered human waste (Table 36). Waste was often marked by toilet paper, which was also noted in Table 12, and dug holes (Table 35).

Table 36. Improperly Disposed Human Waste

Human Waste	Frequency	Percent
Yes	27	20
No	108	80
Total	135	100

At a small portion of WinGate campsites (~13%; n=18), visible trails were evident to and from the campsites (Table 37).

Table 37. Visible Visitor Trails

Visible Visitor Trails	Frequency	Percent
Yes*	18	13.3
No	117	86.7
Total	135	100

* Sites with impacts from cattle may have hidden some of the anthropogenic-caused trails.

Approximately 28% (n=38) of the WinGate campsites contained trampled cryptobiotic soils and crusts around the campsites (Table 38).

Table 38. Disturbed Cryptobiotic Crusts in and around Campsite

Disturbed Cryptobiotic Crusts	Frequency	Percent
Yes	38	28.1
No	97	71.9
Total	135	100

Approximately 11% (n=15) of the WinGate campsites contained campsite furniture (Table 39). Furniture consisted of items that were positioned or crafted to make the campsites more comfortable. These items frequently included large downed logs or ritualistic structures.

Table 39. Campsite Furniture Level

Level of Campsite Present	Frequency	Percent
None	115	85.2
Some	15	11.1
A lot	5	3.7
Total	135	100

At the majority (~87%; n=118) of WinGate campsites that were evaluated, no visible access trails were located (Table 40).

Table 40. Visible Access Trails To/From Campsite

Access Trails	Frequency	Percent
None	118	87.4
1	9	6.7
2	3	2.2
3	1	.7
4	2	1.5
5	1	.7
7	1	.7
Total	135	100

The researchers noted the amount of human waste present at the WinGate campsites (Table 41). The majority (~79%; n=21) did not have any signs of human waste. However, ~16% (n=21) did have at least one location where human waste was counted.

Table 41. Frequency (Count) of Human Waste Seen at a Single Campsite

Human Waste Count	Frequency	Percent
None	107	79.3
1	21	15.6
2	3	2.2
3	1	.7
4	2	1.5
7	1	.7
Total	135	100

Litter estimates were taken at each of the WinGate campsites that were evaluated (Table 42). The majority (57%) of campsites did have some level of litter present. At ~37% (n=50) of the campsites, researchers discovered “hand-full” (2x2x2 in.) amounts of trash. At ~4% (n=6) of the sites, researchers found litter amounts that equated to a gallon-sized bag of trash.

Table 42. Litter Estimate at Campsite

Litter Estimate	Frequency	Percent
None	58	43
Micro-trash (.2x.2x.2 in.)	9	6.7
Hand-full (2x2x2 in.)	50	37

Quart bag	12	8.9
Gallon bag	6	4.4
Total	135	100

Discussion and Implications

Roadside/PEB Campsites (Non-WinGate)

Characteristics of roadside and non-WinGate campsites/PEBCs were summarized in tables 6-25 above. The majority of PEBCs were considered to have low, or moderate levels of visitor-related impacts. The majority of these sites were located in areas that had 75-100% potential for expansion, given the landscape features surrounding the sites. One of the most common impacts was evidence of fire, which was notable at the majority of PEBCs. Litter and visible trails to and from the sites were also evident at a substantial number of these non-WinGate campsites.

Additional analyses will be conducted after 2017 data collection, when the total sample of roadside campsites will be substantial enough for comparisons within the data. We intend to examine trends in site condition over time by comparison of sites included in monitoring efforts that were collected prior to inventories provided in this report (i.e., prior to 2016). Additional analyses will examine conditions present at roadside sites relative to environmental, managerial, and social pressures present on the monument. These factors will include proximity to roads, trails, towns, other infrastructure, and classification of the landscape by WSAs and other designations. Continued monitoring, as well as additional direct and indirect strategies (e.g., education and communication) are warranted to ensure that visitors are compliant with management objectives for these sites. In particular, measures to ensure that sites do not expand, particularly given the potential for expansion at the majority of the sites measured, as well as strategies to reduce avoidable impacts will be pertinent to implement should GSENM management deem feasible and appropriate.

WinGate Wilderness Therapy Program Campsites

Field staff were able to locate and assess 135 of the camping locations used by WinGate Wilderness Therapy. While we were initially apprehensive about distinguishing WinGate campsites from those used by other GSENM visitors, this turned out not to be a problem given

the some of the easily apparent and commonly present campsite features. WinGate campsites are located near, but removed from, the GSENM primitive road system, generally lacking connecting informal trails. They camp near roads to facilitate the delivery of food, water, and supplies, and to retrieve trash. Furthermore, several forms of camping impacts observed on the campsites were uniquely WinGate-specific, such as stripped bark from cedar trees, the presence of charcoal but absence of a fire site, and several unique, WinGate-associated types of litter.

Nationally, most native plant communities have vegetative ground cover or organic litter that covers the majority of the ground surface and trampling disturbance from recreational activities is reasonably easy to detect. However, this was not the situation within the GSENM study areas. The native plant communities within the study area have a great deal of natural patchiness, with plants interspersed by bare soil. Subsequently, we found that campsite boundaries were frequently difficult to discern. Disturbance from livestock grazing and trampling were also evident throughout the study area. Following considerable observation and discussion, we concluded that an accurate and precise (repeatable) determination of campsite boundaries was not possible. This prevented application of several traditional campsite-monitoring practices employed in most other protected natural areas. Furthermore, the WinGate program practices disperse camping at the low end of the use spectrum, where, if successful, campsite boundaries never develop. Due to these issues, the WinGate campsites generally lacked visually discernable camping impact boundaries, though some sites had visually obvious camping disturbance with partial boundaries in some areas (Figure 9).

Figure 9. Example WinGate Campsites (Campsite condition assessments were difficult, due to the patchiness of native vegetation and livestock disturbance (left). However, some camping locations appeared to have clear camping-related trampling disturbance, with partially discernable boundaries (right)).

A core interest was the degree to which the WinGate's dispersed camping practices effectively prevent long-term camping disturbance, which we define as any disturbance that cannot recover to near-natural and non-discernable conditions within one year. As noted in the Literature Review section, successful application of the dispersal strategy requires that visitors do not repeatedly reuse the same campsites. We begin by discussing our findings from an analysis of WinGate campsite SPOT data (Table 27). For the years we have data (2014-2016), WinGate crews used our study sites two times (26%), three times (11%), four times (9%), and five times (6%). Only 44% of the sampled WinGate sites were occupied a single night, though it is likely that some were used in the years preceding 2014, for which we lack data (WinGate has been operating in the study area for eight years). We note that many of the WinGate campsites occur in clusters, so it can be difficult, in some instances, to differentiate between the campsites based on the SPOT data due to inherent spatial inaccuracies. Regardless, it's clear that repeat use occurs on the campsites both within years and across years. We stress that such repeat use and the clustering of campsites are both problematic for achieving success under a dispersed pristine site camping strategy.

Recall that our measurements were conducted in September 2016, while the camping use occurred in 2014 (39%), 2015 (20%), and 2016 (25%), with 14+% of sites used two or more years (Table 26). This means that about 25% of the sites were assessed <9 months after use, 20% were assessed 9-21 months after use, and 39% were assessed 21-33 months after use. Based on these findings, nearly 60% of the WinGate campsites should have recovered to near-natural conditions if impacts were kept at or below levels able to recover in a one-year period.

Other relevant impact indicators are summarized in Table 43, which includes the percentage of "present" or "unsuccessful" conditions for 12 campsite indicators. For the "obvious use area" indicator we see that 83% of the WinGate sites have visible impact. The remaining 17% that lacked obvious trampling disturbance were identified as WinGate campsites by the presence of other forms of impact that we associated with WinGate campsites. Most of these indicators are "avoidable" forms of impact when campers apply low impact practices applicable to dispersed "pristine site" camping (Marion, 2014), which are mostly also included in the low impact guidance contained in WinGate's official staff manual (WinGate, 2016). The guidance from that manual for the 12 impact indicators are provided in Table 44 and Appendix B.

Table 43. Summary of impact indicator "Present" data for WinGate campsites as measures for evaluating dispersed camping efficacy.

Impact Indicator	Present on Campsites

	(% of campsites)
Obvious use area	83
Fire sites	32
Charcoal/ashes	43
Litter	86
Collected firewood	26
Tree/shrub damage	28
Bark stripping	33
Holes dug-up	50
Human waste	20
Visible visitor trails	13
Disturbed cryptobiotic crusts	28
Campsite furniture	15

Table 44. WinGate Wilderness Therapy low impact practices relevant to 12 impact indicators.

Impact Indicator	WinGate Low Impact Practices*
Obvious use area	Camp on durable surfaces. When possible, use a site which naturally lacks vegetation, such as exposed bedrock or sandy areas.
Fire sites	Build fires only on fire blankets. Find or make a slight bowl-shaped area to put the fire blanket. Allow wood to burn to white ash.
Charcoal/ashes	Not described in the manual but we know they carry cans to sift ashes/coals in offsite areas.
Litter	The campsite will remain clean and orderly at all times. Personal mesh screens will be used to strain dish water from left-over food particles. All leftover food particles will be placed in personal plastic trash bags and packed out. Toilet paper & tampons: both will be placed in personal plastic trash bags and packed out. Clean sweep: When departing camp the Senior Trail Instructor will inspect and assure that the site has been completely naturalized. Make sure there is no sign of any part of the camp, including any sign of food particles or debris from making trail skills.
Collected firewood	Wood shall be gathered in a tightly arranged pile and broken down into pieces no larger than 2” in diameter and 1’ long.
Tree/shrub damage	Collect only dead, down and detached wood for burning. Never break wood off of any dead or alive standing tree.
Bark stripping	Not addressed in the manual but this is a very common practice.
Holes dug-up	Manual does not direct users to fill in catholes, latrines, or sump holes.

Human waste	Dig catholes at least 8 inches deep. Dig latrines at least 10 inches deep, 10 inches wide, and 20 inches long.
Visible visitor trails	Consciously choose durable routes (and alternate those routes) of travel between parts of your camp so that connecting trails do not develop.
Disturbed cryptobiotic crusts	Do not walk or camp on cryptobiotic crusts if at all possible. Where damage is unavoidable, hike in a tight line and seek a durable surface as soon as possible.
Campsite furniture	Assure that the site has been completely naturalized.

*Source: WinGate Therapy Program Training Manual

In the case of building a fire, WinGate field procedures direct campers to dig a shallow pit and line it with a fiberglass fire blanket. Though not described in the manual, we were informed by WinGate staff that campers are instructed to collect and sift all extinguished campfire coals and ash through perforated steel cans (Figure 10). Other campfire-related impacts included bark stripping, tree/shrub damage, and collected firewood. WinGate participants make their campfires using a personally made bow and spindle with stripped cedar tree bark used as tinder. While instructed to follow low impact practices of collecting only dead and downed wood, we found evidence of freshly broken tree and shrub limbs in the vicinity of 28% of WinGate campsites, while bark stripping from cedar trees was found near 33% of WinGate campsites (Figure 11). While only a small handful of cedar bark is necessary for fire starting, we note that extensive and visually obvious bark stripping was common.

Litter left behind was the most common type of impact assessed on the WinGate sites, evident on 86% of their campsites. This is a very high percentage, given that the participants are able to pack up their litter and leave it by the side of an adjacent road for pick-up. Common types of trash included pieces of parachute cord that WinGate crews use to tie up tarps, various food packaging (particularly Starkist Tuna), WinGate food order lists, pens, and tampon applicators (Figure 12). We also saw dug holes that we surmised were sump holes that did not get filled in within or near half of the campsites. We conducted searches in the areas around each campsite to look for evidence of improperly disposed human waste. We found a few locations with surface-disposed human waste but more frequently found toilet paper, wipes, tampon applicators, and tampons at the surface. One or more of these items was found on 20% of the WinGate sites. Other impacts included visitor trails (13%) and evidence of camping or trampling/trails on cryptobiotic crusts (28%). Finally, we found campsite furniture on 15% of the sites, including sitting logs and elaborate ceremonial rings on about five campsites (Figure 13).

Figure 10. Example WinGate Fire Sift and Charcoal (A steel can (left) found on a WinGate campsite are used to sift coals, which are supposed to be carried out as trash, from ash, which is scattered away from the camping area prior to departure. However, evidence of WinGate campfire sites, predominantly clusters of charcoal (right), were found on 32% of the WinGate sites).

Figure 11. Evidence of tree/shrub damage and excessive bark stripping on cedar trees found near WinGate campsites.

Figure 12. Examples of trash found on WinGate campsites.

Figure 13. Elaborate ceremonial rings were found on or near several WinGate campsites.

Summary and Suggestions: Our WinGate findings indicate that many of their field staff and participants are not following the low impact guidance in their manual (i.e., pages 98-104). In particular, we are puzzled by finding numerous instances of impacts that are entirely avoidable, including litter/trash, damaged trees and excessively striped bark, holes left unfilled, ceremonial rings, and surface-disposed human waste. This appears to be due to a breakdown in the WinGate field staff in teaching and ensuring that participants follow the low impact camping practices included in the WinGate field manual (WinGate, 2016). Improvements are needed, along with a program of random field checks to ensure future accountability.

Our findings also reveal a considerable amount of repeat use of dispersed camping locations that is creating lasting impact that does not recover in a single year. Such use is creating dozens of visually obvious backcountry campsites which represent a failure of both WinGate and Monument dispersed camping practices and program objectives. WinGate field staff may not

always be able to comply with such guidance when problems related to their participants or the weather develop (uncooperative participants and related emergencies and/or extreme/unsafe weather events). Recreation ecology research reveals that camping more than a few nights/year on the same spot will lead to the creation of a new campsite with lasting visible groundcover disturbance (Marion 2016, Marion et al. 2016, Hammitt et al. 2015). For dispersed pristine site camping to avoid creating lasting resource impacts we suggest that they seek to camp at each location only once a year, *avoiding all spots that exhibit prior evidence of camping*. Our findings clearly indicate that this is not currently their practice.

We suggest that WinGate develop additional low impact policies that incorporate improved dispersed pristine site camping practices AND established site camping practices that concentrate camping on sustainable sites that receive repeat use. Regarding improved dispersed camping practices, we've included the most relevant excerpts from the Leave No Trace program's book (Marion 2014) in Appendix C. We are available to collaborate with WinGate or Monument staff in assisting to develop or review revised Leave No Trace practices. Regarding established site camping practices, we suggest that within each commonly used area they could identify a designated campsite for use whenever they are unable to move each night and use only that site when repeated camping at one location is necessary. Campsite practices for this form of concentrated camping are also included in Appendix C. Recreation ecology research reveals that concentrating repeat use on a single site within each area will result in far less cumulative impact than would camping many times per year on a larger number of dispersed campsites (Marion 2016).

Phase Two: Proposed Research

Anticipated 2017 Sampling

The overarching objectives of this phase of research will be to continue monitoring and recording backcountry recreational use impacts in some of the higher use areas of GSENM, including several WSAs, including: Escalante Canyon Gulch, Phipps Death Hollow, and Scorpion. Specifically, during late September and early October 2017 (~September 23 – October 5), we propose that our collaborative team will collect data within GSENM in the following locations:

1. Calf Creek Recreation Area (All) - Hiking supported by vehicle
2. Spencer Flat - road based
3. Hole-in-the-Rock Road - road based
4. Escalante River, Boulder Mail Trail, Death Hollow - Backpacking portion

In consultation with GSENM, these locations were proposed due to the unique

landscape features that attract varied types of users (e.g., backcountry; frontcountry/roadside) at moderate to high volumes of use, leading to increased concern about the ecological and social conditions in the area.

Future Research

Regarding future years of research, building upon the specific findings from the 2016 monitoring data, we propose additional collaboration to explore management and permitting of WinGate Wilderness Therapy and other commercial uses on the monument. Likely collaboration includes review of existing management and guidance for the programs and recommendations for altered or improved guidance and management. Additional investigation of spatial patterns of use as related to program activities, impacts to natural resources, and distribution of use across management and environmental zones within the monument is anticipated.

Additional monitoring research is merited in primitive recreation zones, such as the 16 WSAs, comprising approximately 879,099 acres managed in GSENM. Increasing use, particularly day-use, in these areas, paired with the consistent if not slightly escalating backcountry use justifies specific consideration for these areas. Monitoring, paired with the application of direct (e.g., closures, permits, regulations, zones) and indirect (e.g., education, communication, interpretation, Leave No Trace) management approaches in the form of experimental treatments, may highlight suitable management options that could be implemented more regularly to mitigate ecological impacts while improving social experiences in these high use areas.

Finally, the 15-year strategy, as prescribed in the BLM's "Geography of Hope" (2011) suggests that GSENM must "identify research needs and incorporate physical, biological, and social science" to inform adaptive management, interpretation and outreach (Theme 1; Goal 1c). This strategy specifically suggests that the agency "conduct periodic visitor surveys" to examine the experiential qualities of their needs (Theme 2; Goal 2d). To date, the Monument has facilitated very little social science. The most recent examination applied focus group methodologies to suggest that visitors to GSENM seek naturalness and tranquility in the remote and rugged landscape, which promotes self-reliance and discovery (Casey, 2014). While this study was extremely valuable in aiding the Monument determine appropriate visitor use management strategies, focus groups tend to draw the opinions of stakeholders (i.e., often surrounding landowners, concessionaire managers, etc.) and often fails to capture the opinions of general visitors. The dearth of social science in GSENM, paired with the prescribed need for

this type of examination as stated in the long-term BLM planning strategies (see, The Geography of Hope, 2011), merits additional experiential examinations with visitors at the Monument. Pairing the ecological monitoring data with social science data could aid in achieving sustainable management strategies despite the high use in the Monument's primitive and ecologically sensitive environment.

References

Barros, A., & Pickering, C. M. (2015). Impacts of experimental trampling by hikers and pack animals on a high-altitude alpine sedge meadow in the Andes. *Plant Ecology & Diversity*, *8*(2), 265-276.

BlueFire Wilderness Therapy. *Wilderness Therapy for Teens*. Retrieved from http://www.bluefirewilderness.com/

Bureau of Land Management National Landscape Conservation System Science Strategy (2007). BLM/WO/GI-06/027+6100.

Casey, T. (2014). Recreation experience baseline study report for Grand Staircase-Escalante National Monument Executive Summary. Report published by The Natural Resource Center at Colorado Mesa University.

Cole, D. 1987. Effects of three seasons of experimental trampling on five montane forest communities and a grassland in western Montana, USA. *Biological Conservation 40*, 219-244.

Cole, D. N. (1992). Modeling wilderness campsites: Factors that influence amount of impact. *Environmental Management*, *16*(2), 255-264.

Cole, D. N. (1993). Minimizing conflict between recreation and nature conservation.

Cole, D. N. (1995). Experimental trampling of vegetation. I. Relationship between trampling intensity and vegetation response. *Journal of Applied Ecology*, 203-214.

Cole, D. N. (2004). Impacts of hiking and camping on soils and vegetation: a review. *Environmental Impacts of Ecotourism*, *41*, 60.

Cole, D. N. (2013). Changing conditions on wilderness campsites: Seven case studies of trends over 13 to 32 years.

Cole, D. N., & Benedict, J. (1983). *Wilderness Campsite Selection: What Should Users be Told?*. publisher not identified.

Cole, D. N., & Monz, C. A. (2003). Impacts of camping on vegetation: response and recovery following acute and chronic disturbance. *Environmental Management*, *32*(6), 693-705.

Cole, D. N., & Monz, C. A. (2004). Spatial patterns of recreation impact on experimental campsites. *Journal of Environmental Management*, *70*(1), 73-84.

Cooley, R. (1998). Wilderness therapy can help troubled teens. *International Journal of Wilderness, 4*(3), 18-21.

Davis-Berman, J. & Berman D. (2008). *The promise of wilderness therapy*. Boulder, CO: Association for Experiential Education.

Gass, M., Gillis, H., & Russell, K. (2012). *Adventure therapy: Theory, practice, and research*. New York, NY: Routledge.

Graefe, A.R., K. Cahill, & J. Bacon. 2011. Putting visitor capacity in perspective: A response to the Capacity Work Group. *Journal of Park & Recreation Administration,* 29(1), 21-37.

Grand Staircase-Escalante National Monument Management Plan (2000). BLM/UT/PT-099/020+1610.

Grumbine, R. E. (1994). What is ecosystem management?. *Conservation biology*, *8*(1), 27-38.

Farrell, T.A., & J.L. Marion. (2002). The Protected Areas Visitor Impact Management (PAVIM) framework: A simplified process for making management decisions. *J. of Sustainable Tourism* 10(1), 31-51.

Hammitt, W. E., Cole, D. N., & Monz, C. A. (2015). *Wildland Recreation.* New York: John Wiley & Sons.

Hendee, J.C., & C.P. Dawson. (2002). *Wilderness management: Stewardship and protection of resources and values*. The WILD Foundation, Fulcrum Publ., Golden, CO.

Hill, R., & Pickering, C. (2009). Differences in resistance of three subtropical vegetation types to experimental trampling. *Journal of Environmental Management*, *90*(2), 1305-1312.

Hoag, M., Massey, K., Roberts S., & Logan, P. (2013). Efficacy of wilderness therapy for young adults: A first look. *Residential Treatment for Children & Youth*, 30, 294-305.

Lariviere, M., Couture, R., Ritchie, S., Cote, D., Oddson, B., & Wright, J. (2012). Behavioral assessment of wilderness therapy participants: Exploring the consistency of observational data. *Journal of Experiential Education*, *35*, 290-302.

Leung, Y. F., & Marion, J. L. (1999). Assessing trail conditions in protected areas: Application of a problem-assessment method in Great Smoky Mountains National Park, USA. *Environmental Conservation*, *26*(04), 270-279.

Leung, Y.F., & J.L. Marion. (2000). Recreation impacts and management in wilderness: A state-of- knowledge review. P. 23-48 in Wilderness science in a time of change conference,

Vol. 5, USDA For. Serv. Proc. RMRS-P-15-VOL-5.

Leung, Y.F., and J.L. Marion. (2004). Managing impacts of campsites. P. 245-258 in *Environmental impact of tourism*, Buckley, R. (ed.), CABI Publ., Cambridge, MA.

Littlemore, J., & Barker, S. (2001). The ecological response of forest ground flora and soils to experimental trampling in British urban woodlands. *Urban Ecosystems*, *5*(4), 257-276.

Lynn, N., & Brown, R. (2003). Effects of recreational use impacts on hiking experiences in natural areas. *Landscape and Urban Planning*, *64*(1-2), 77-87.

Manning, R. (2007). *Parks and carrying capacity: Commons without tragedy*. Island Press, Wash.

Manning, R. (2011). *Studies in outdoor recreation: Search and research for satisfaction* (3rd Edition). Oregon State University Press.

Manning, R., & Anderson, L. E. (2012). *Managing outdoor recreation: Case studies in the national parks*. CABI.

Marion, J. (2014). *Leave No Trace in the outdoors*. Stackpole Books.

Marion, J. (2016). A review and synthesis of recreation ecology research supporting carrying capacity and visitor use management decision making. *Journal of Forestry, 114*(3), 339-351.

Marion, J.L., & D.N. Cole. (1996). Spatial and temporal variation in soil and vegetation impacts on campsites: Delaware Water Gap National Recreation Area. *Ecological Applications* 6(2), 520- 530.

Marion, J., Leung, Y., Eagleston, H., & Burroughs, K. (2016). A review and synthesis of recreation ecology research findings on visitor impacts to wilderness and protected natural areas. *Journal of Forestry, 114*(3), 352-362.

Marion, J. L., & Wimpey, J. (2011). *Informal trail monitoring protocols: Denali National Park and Preserve*. US Geological Survey.

Monz, C. A., Cole, D. N., Leung, Y. F., & Marion, J. L. (2010). Sustaining visitor use in protected areas: future opportunities in recreation ecology research based on the USA experience. *Environmental Management*, *45*(3), 551-562.

National Conservation Lands Bureau of Land Management – Utah 5-Year Strategy (2014-2019).

National Park Service. 1997. A summary of the Visitor Experience and Resource Protection (VERP) framework. USDI Nat. Park Serv. Denver Serv. Ctr. Publ. NPS D-1214. 35 p.

Newsome, D., Moore, S. A., & Dowling, R. K. (2012). *Natural area tourism: Ecology, impacts and management* (Vol. 58). Channel View Publications.

New Vision Wilderness Therapeutic Outdoor Programs. *New Vision Wilderness Therapy*. Retrieved from http://newvisionwilderness.com/

Newsome, D., Moore, S. A., & Dowling, R. K. (2012). *Natural area tourism: Ecology, impacts and management* (Vol. 58). Channel View Publications.

Norton, C., Tucker, A., Russell, K., Bettmann, J., Gass, M., Gillis, H., & Behrens, E. (2014) Adventure therapy with youth. *Journal of Experiential Education*, *37*, 46-59.

Open Sky Wilderness Therapy. *Open Sky Wilderness*. Retrieved from http://www.openskywilderness.com/

Pickering, C. M. (2010). Ten factors that affect the severity of environmental impacts of visitors in protected areas. *AMBIO: A Journal of the Human Environment*, *39*(1), 70-77.

Pickering, C. M., Hill, W., Newsome, D., & Leung, Y. F. (2010). Comparing hiking, mountain biking and horse riding impacts on vegetation and soils in Australia and the United States of America. *Journal of Environmental Management*, *91*(3), 551-562.

RedCliff Ascent Wilderness Treatment Program. *Troubled Teen Help Wilderness Therapy Program Over 20 Years of Success*. Retrieved from http://www.redcliffascent.com/

Reid, S. E., & Marion, J. L. (2004). Effectiveness of a confinement strategy for reducing campsite impacts in Shenandoah National Park. *Environmental Conservation*, *31*(04), 274-282.

Roovers, P., Baeten, S., & Hermy, M. (2004). Plant species variation across path ecotones in a variety of common vegetation types. *Plant Ecology*, *170*(1), 107-119.

Russell, K. & Hendee, J. (2000). Wilderness therapy as an intervention and treatment for adolescents with behavioral problems. In: Watson, Alan E.; Aplet, Greg H.; Hendee, John C., comps. 2000. Personal, societal, and ecological values of wilderness: Sixth World Wilderness Congress proceedings on research, management, and allocation, volume II; 1998 October 24–29; Bangalore, India. Proc. RMRS-P-14. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, 136-141.

Stankey, G. H., Cole, D. N., Lucas, R. C., Petersen, M. E., & Frissell, S. S. (1985). The limits of acceptable change (LAC) system for wilderness planning. *The limits of acceptable change (LAC) system for wilderness planning.*, (INT-176).

Stewart, W. (1989). Fixed itinerary systems in backcountry management. *Environmental Management, 29,* 163-171.

The Journey Wilderness. *Wilderness Therapy Program for Teens and Adults: The Journey Wilderness*. Retrieved from http://journeywilderness.com/

The National Landscape Conservation System 15-year Strategy (2010-2025). The Geography of Hope. (2011). Bureau of Land Management/WO/GI-11/013+6100. (www.blm.gov/wo/st/en/info/newsroom/2011/September/NR_09_30_2011.html).

Tucker, A., Norton, C., DeMille, S., & Hobson, J. (2016). The impact of wilderness therapy. *Journal of Experiential Education*, *39*(1), 15-30.

Wagar, J.A. (1964). The carrying capacity of wildlands for recreation. *Forestry Science Monogr. 7,* p. 23, Society of American Foresters, Washington, D.C.

Whinam, J., & Chilcott, N. M. (2003). Impacts after four years of experimental trampling on alpine/sub-alpine environments in western Tasmania. *Journal of Environmental Management*, *67*(4), 339-351.

Whittaker, D., S. Shelby, R. Manning, D. Cole, & G. Haas. (2011). Capacity reconsidered: Finding consensus and clarifying differences. *Journal of Park & Recreation Administration 29*(1), 1-19.

Wimpey, J., & Marion, J. L. (2011). A spatial exploration of informal trail networks within Great Falls Park, VA. *Journal of Environmental Management*, *92*(3), 1012-1022.

Appendices

Appendix A: Data Dictionary

Campsite Assessment Manual

Grand Staircase-Escalante National Monument (GSENM)

(*version 9/16/2016*)[1,2]

This manual describes procedures for conducting inventories and resource condition assessments of campsites within the Grand Staircase-Escalante National Monument (GSENM). Procedures are also described for future reassessments to allow monitoring of site conditions over time. These procedures will document and permit monitoring of changes in site conditions and allow statistical modeling to evaluate factors that influence site conditions. Three general approaches are used for assessing site conditions: 1) digital photographs, 2) a condition class assessment determined by visual comparison with described levels of trampling impact, and 3) predominantly measurement-based assessments of impact indicators.

For the purposes of this manual, campsites are defined as areas of visually obvious disturbed vegetation, surface litter, or substrates caused by overnight visitor use located within the GSENM areas selected for monitoring. Day-use recreation sites will be omitted unless there is evidence or the likelihood of overnight use. Careful searches of these monitoring areas will be conducted to locate and assess all campsites, which will be found by driving all legally open roads, with foot searches to check out all likely side-routes, trails, and GPS points (for WinGate sites within 500 ft of roads). Note: there must be clear (compelling) visitor trampling-related disturbance to record a site and some protocols will only be applied when there are visually obvious site boundaries, otherwise no measurements will occur.

Assessments should be taken near the middle or end of the visitor use season generally late summer to fall months are best (e.g., August-September). Site conditions generally recover during the late fall/winter/early spring periods and often reflect rapid impact during early (spring) season use. Site conditions are more stable during the mid- to late-use season and reflect the resource impacts of that year's visitation. Subsequent assessments, if conducted, should be completed as close in timing to the original year's measures as possible, ideally within 1-2 months.

Recommended Field Assessment Gear

(Check before leaving for the field)

- Topographic and road maps.
- Trimble and/or Garmin GPS units w/spare batteries, stylus, and the campsite data dictionary. Loaded with GSENM and monitoring area boundaries and data dictionary.
- Sonin Combo Pro distance measuring unit w/fresh batteries and/or tape measure (100 ft. in tenths).
- This manual on waterproof paper with backup field forms (forms/photos from previous survey)
- Tablet computer with internal forms for data entry, backup power supply, gallon trash bag & umbrella.
- Digital Camera w/spare batteries.
- Clipboard, monitoring manual, blank field forms (some on waterproof paper), small notebook, calculator, pens.
- Power bricks and cords to attach all electronic gear to replenish equipment batteries in the field.

1 - Developed by Dr. Jeffrey L. Marion, U.S. Geological Survey, Virginia Tech Field Station, FREC (0324), Blacksburg, VA 24061, 540/231-6603, jmarion@vt.edu; Dr. Jeremy Wimpey, Applied Trails Research, 1310 N Allen St., State College, PA 16803; 443/629-2630, appliedtrailsresearch@gmail.com; and Dr. Derrick Taff, Pennsylvania State University, Dept. Recreation, Park & Tourism Management, 814/867-1756, bdt3@psu.edu

General Site Information

1) **Site Number**: Record the Monitoring Area code followed by a unique site number.

2) **WinGate:** Y/N, If Yes, record #/nights by year: 2016 ___, 2015 ___, 2014 ___.

3) **Inventoried by**: Identify the name of field personnel assessing the site.

4) **GPS**: GPS coordinates for site, WGS84 datum. Use a Trimble or Garmin GPS and collect an averaged point at the center of each campsite. Record the code for this waypoint here.

5) **Date**: Month, day, and year the site was evaluated (e.g. Sept. 20, 2016 = 09/20/16).

6) **Impact/Use Level**: N = None, L = Low, M = Moderate, H = Heavy. Based on appearances and recency of use.

7) **Discernable Campsite Boundaries**: 1 = Yes, 2 = No clear boundaries but some visitor impact traces are present (see item 17), 3 = No impact traces found (recorded only for visited WinGate campsite locations – end assessment). ***Note:*** A much reduced set of the following indicators are assessed when this indicator is evaluated as a "2" – no clear campsite boundaries are present.

8) **General Comments**: Comments related to general site info indicators. Include additional info on site location, type, amount, and recency of use.

Inventory Indicators

9) **Vehicle Access**: Is there an obvious roadside vehicle parking area with a trail <100 ft long leading to the campsite? Y/N Are there vehicle ruts leading to the campsite? Y/N

10) **Visibility, Road**: Rate the campsite visibility from the nearest legal use road: V = Visible (site is clearly visible), M = Moderate (site could be missed if not occupied), N = Not visible. ***Note:*** Distance to road, trail, and other campsites can be derived with GIS.

11) **Site Expansion Potential**: Consider the adjacent areas up to 50 ft beyond campsite boundaries in a 360^{o} arc. Record the percentage of this area that would greatly inhibit tenting activity due to steep slopes (>20% grade) or rockiness. For example, an estimate of 70% indicates that 30% of the offsite areas are sufficiently flat that tenting activity could occur there (*Note:* disregard all current woody and herbaceous vegetation – these are easily removed by woods tools, insect kills, and forest fires).

12) **Shade**: Imagine that the sun is directly overhead and estimate the percentage of the site that is shaded by the trees, shrubs, or cliffs; record the mid-point value.

	0-5%	6-25%	26-50%	51-75%	76-95%	96-100%
Midpoints:	**2.5**	**15.5**	**38**	**63**	**85.5**	**98**

13) **Rock Substrate**: Estimate the percentage of rock substrate within campsite boundaries, including bedrock or rocks (barren or lichen-covered).

	0-5%	6-25%	26-50%	51-75%	76-95%	96-100%
Midpoints:	**2.5**	**15.5**	**38**	**63**	**85.5**	**98**

14) **Vegetation Type**: Record the predominant type of vegetation for the majority of the campsite:
T = Trees, TS = Tall Shrubs (>3 ft), SS = Short Shrubs (<3 ft), GH = Grass/herbs, BS = Barren/Slickrock
15) **Water**: N = None w/in 250 ft, ST = Stream, SP = Spring, L = Livestock/Wildlife, P = Potholes

16) **Inventory Comments**: Comments related to general site info indicators.

Note: A 2003 NRCS Soil Survey will be accessed through GIS to ID soil types and capabilities/limitations. A 2004 USGS Landcover and vegetation type survey will be accessed through GIS to ID landcover and vegetation types. Other datasets accessed through the monument's GIS system for additional indicators include: 1) data for sensitive, rare, and native/non-native plant communities, 2) grazing attributes, 3) annual precipitation averages, 4) sensitive cultural/archaeological/paleontological sites, 5) administrative and management zoning classifications, and 6) other data layers as needed.

Impact Indicators

17) **Impact Traces (if 1 or 2 in #7)**: Record any of the following visitor-related traces (Not livestock):

Fire site: Y/N Scattered ashes/charcoal from a campfire: Y/N Obvious use area(s): Y/N

Litter: Y/N Footprints: Y/N Reduction of firewood: Y/N/NA Collected firewood: Y/N/NA

Recent tree/shrub damage: Y/N/NA Holes dug up: Y/N Visitor Trails: Y/N Bark stripping: Y/N

Disturbed Cryptobiotic crusts: Y/N Improperly disposed human waste: Y/N

Other: _____

Comments:

_____

Note: Use areas can be from tenting/cooking and are distinguished by the absence of rocks, veg, litter, or woody materials. Holes may be from animals digging up catholes, greywater disposal or peeing spots, or buried food or coals.

The size of campsites with visible boundaries will be determined with the **Geometric Figure Method,** which is quite accurate when applied with good judgment. Carefully study the site's shape, as if you were looking down from above. Mentally superimpose and arrange one or more simple geometric figures to closely match the site boundaries. Any combination and orientation of these figures is permissible (see Figure 1). Project site boundaries straight across areas where trails enter the site.

Include any adjacent associated ***"satellite"*** tenting spots or use sites. Satellite spots are often small adjacent tenting sites but can also be a cooking or water access site. Use your judgment to separate out and exclude nearby campsites or day-use sites. Sometimes (rarely) there can be an essentially ***"undisturbed island"*** of vegetation within a campsite boundary. If present, measure and record the dimensions of these islands in the comment field – their area will be subtracted from the campsite.

Identify site boundaries by pronounced human disturbance-related changes in vegetation cover, vegetation height/disturbance, vegetation composition, or surface organic litter (illustrative photographs will be provided to field staff during training). Include vehicle parking and turning spots located within campsite boundaries but not traffic-related impacts that extend like routes or roads away from the campsite, or external parking spots along roads. There may be very little vegetation and it will be necessary to identify boundaries by examining changes in organic litter or soil disturbance, i.e. leaves which are untrampled and intact vs. leaves which are pulverized or absent. Include only those areas that appear to have been disturbed from visitor trampling or vehicles (disregard livestock impacts). When in doubt, it may also be helpful to speculate on which areas typical visitors might use based on factors such as slope or rockiness. This may be common in many areas due to the presence of naturally occurring exposed soils in offsite areas.

Good judgment is required in making the necessary measurements of each geometric figure. As boundaries will never perfectly match the shapes of geometric figures, you will have to mentally balance disturbed and undisturbed areas included and excluded from the geometric figures used. For example, in measuring an oval site with a rectangular figure, you would have to exclude some of the disturbed area along each side in order to balance out some of the undisturbed area included at each of the four corners. It may help, at least initially, to place plastic tape or wire flags at the corners of each geometric figure used. In addition, be sure that the opposite sides of rectangles or squares are the same length. Measure (nearest 1/10th foot) the dimensions necessary for computing the area of each geometric figure using the Sonin units (see operating instruction at end of this manual).

18) **Total Site Area**: The total campsite area will be computed from the recorded measurements. In the field, record all necessary geometric figures used with their essential measurements in tenths of feet in a notebook labelled with the site number. Calculate site size (use tablet calculator if necessary) and enter the site size (ft^2).

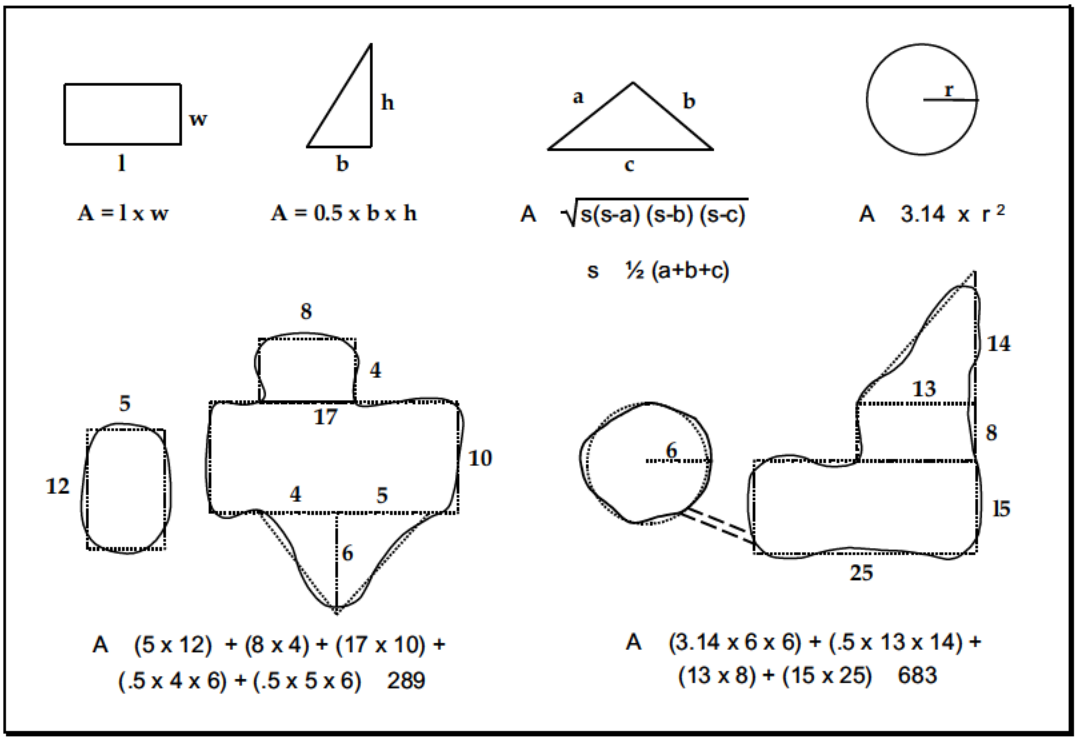


Figure 1. The Geometric Figure Method for determining campsite size.

19) **Condition Class**: Record a campsite Condition Class using the descriptions below.

Rock (R): Site is predominantly on rock surfaces so the effects of trampling are difficult to see/assess.

Class 1: Site barely distinguishable; slight loss of vegetation cover and /or minimal disturbance of organic litter.

Class 2: Site obvious; vegetation cover lost and/or organic litter pulverized in primary use areas.

Class 3: Vegetation cover lost and/or organic litter pulverized on much of the site, some bare soil exposed in primary use areas.

Class 4: Nearly complete or total loss of vegetation cover and organic litter, bare soil widespread.

Class 5: Soil erosion obvious, as indicated by exposed tree roots and rocks and/or gullying.

20) **Vehicle Impact**: Within campsite boundaries estimate the percentage of the campsite that appears to be impacted/affected by vehicle traffic and parking.

	0-5%	6-25%	26-50%	51-75%	76-95%	96-100%
Midpoints:	**2.5**	**15.5**	**38**	**63**	**85.5**	**98**

21) **Livestock Impact**: In offsite areas within 100 ft of campsite boundaries assess the extent of the land that is visibly impacted by livestock grazing and trampling. N = None, L = Low, M = Moderate,
H = High

22) **Cultural/Archaeological Resource Impact**:
Y / N: Evidence of cultural or archaeological structures, artifacts, rock art onsite or within 100 ft of the site.
Y / N: Evidence of visitation-related impacts to cultural or archaeological structures, artifacts, rock art onsite or within 100 ft of the site.
Comments: If Yes, describe all visitation-related impacts.

23) **Vegetation Ground Cover On-Site**: Estimate the percentage of live vegetative groundcover < 2 ft tall (including herbs, grasses, tree seedlings, shrubs, mosses, and folios (leaf-like) lichens) within the campsite boundaries using the coded categories listed below (refer to photographs). Exclude crustose lichens, those that closely adhere to rock, as these are difficult to discern and are considerably less susceptible to trampling impacts. Include any disturbed "satellite" use areas and exclude undisturbed "islands" of vegetation. For this and the following two indicators, it is often helpful to narrow your decision to two categories and concentrate on the boundary that separates them. For example, if the vegetation cover is either category (6-25%) or category (26-50%), you can simplify your decision by focusing on whether vegetative cover is greater than 25%. Record only the midpoint value.

	0-5%	6-25%	26-50%	51-75%	76-95%	96-100%
Midpoints:	**2.5**	**15.5**	**38**	**63**	**85.5**	**98**

24) **Vegetation Ground Cover Off-Site**: Estimate the percentage of live vegetative ground cover < 2 ft tall (same as above) in an adjacent "control" area that lacks human disturbance, though it may have livestock disturbance. Use the categories listed above. The control site should be similar to the site in slope, tree canopy cover (extent of sunlight penetration), and other relevant environmental conditions. The intent is to locate an area which would closely resemble the site area had the site never been used. In instances where you cannot decide between two categories, select the category with less vegetative cover. The rationale for this is simply that the first visitors would tend to select a site with the least amount of vegetation. Note that if some of the substrates on the recreation site would likely be barren due to flooding or exposed bedrock then the control vegetation estimates must reflect that.

25) **Exposed Soil On-site**: Estimate the percentage of exposed soil, defined as ground with very little or no organic litter (partially decomposed leaf, needle, or twig litter) or vegetation cover, within the campsite boundaries and satellite use areas (refer to the photographs). Dark organic soil, the decomposed product of organic litter, should be assessed as bare soil when its consistency resembles peat moss. Assessments of exposed soil may be difficult when organic litter forms a patchwork with areas of bare soil. If patches of organic material are relatively thin and few in number, the entire area should be assessed as bare soil. Otherwise, the patches of organic litter should be mentally combined and excluded from assessments. Code as for vegetative cover above.

26) **Exposed Soil Off-site**: Estimate the percentage of exposed soil, defined as ground with very little or no organic litter (partially decomposed leaf, needle, or twig litter), cryptobiotic, or vegetation cover in an adjacent "control" area that lacks human disturbance, though it may have livestock disturbance. Dark organic soil, the decomposed product of organic litter, should be assessed as bare soil when its consistency resembles peat moss. Assessments of exposed soil may be difficult when organic litter forms a patchwork with areas of bare soil. If patches of organic material are relatively thin and few in number, the entire area should be assessed as bare soil. Otherwise, the patches of organic litter should be mentally combined and excluded from assessments. Code as for vegetative cover above.

27) **Cryptobiotic Soils On-site**: Estimate the percentage of visually obvious cryptobiotic soil crust within the site boundaries and satellite use areas. Code as for vegetative cover above.

28) **Cryptobiotic Soils Off-site**: Estimate the percentage of cryptobiotic soil crust in an adjacent "control" area that lacks human disturbance, though it may have livestock disturbance. Code as for vegetative cover above.

29-31) **Tree/Shrub Damage**: Count and tally each live tree (>1 in. diameter at 4.5 ft.) or woody shrub within or on site boundaries to one of the visitor-caused damage rating classes described below (refer to the photographs following these procedures). **Include** trees/shrubs within undisturbed "islands" and **exclude** those in disturbed "satellite" areas. Multiple stems from the same species should be counted as one tree or shrub when assessing damage to any of its stems. Assess a cut stem on a multiple-stemmed tree/shrub as damage, not as a stump. Take into account tree size. For example, damage for a small tree would be considerably less in size than damage for a large tree. Where obvious, assess trees with scars from natural causes (e.g., lightning strikes) as None/Slight.

None/Slight ... No or slight damage such as broken or cut smaller branches, one nail, or a few superficial trunk scars or worn bark.

Moderate ..... Numerous small trunk scars and/or nails or one moderate-sized scar. Abraded bark exposing the inner wood.

Severe..... Trunk scars numerous with many that are large and have penetrated to the inner wood; any complete girdling of tree/shrub (cutting through bark all the way around stem).

32-34) **Root Exposure**: Count and tally each live tree (>1 in. diameter at 4.5 ft.) or woody shrub within or on site boundaries to one of the root exposure rating classes described below. **Include** trees/shrubs within undisturbed "islands" and **exclude** trees in disturbed "satellite" areas. Assessments are restricted to all trees/shrubs within the flagged site boundaries in order to ensure consistency with future measurements. Where obvious, assess trees/shrubs with roots exposed by natural causes (e.g., stream/river flooding) as None/Slight.

None/Slight ... No or slight root exposure such as is typical in adjacent offsite areas.

Moderate ..... Top half of many major roots exposed more than one foot from base of tree/shrub. Generally indicative of soil loss of 2-4 inches.

Severe..... Three-quarters or more of major roots exposed more than one foot from base of tree/shrub; soil erosion obvious. Generally indicative of soil loss of >4 inches

35) **Number of Tree Stumps**: A count of the number of tree stumps (> 1 in. diameter at ground and less than 4.5 feet tall) within or on site boundaries. **Include** trees within undisturbed "islands" and **exclude** trees in disturbed "satellite" areas. Do not include wind-thrown trees with their trunks still attached or cut stems from a multiple-stemmed tree.

36) **Fire Sites**: A count of campfire sites within campsite boundaries, including satellite areas. Include old inactive fire sites as exhibited by blackened rocks, charcoal, or ashes but do not include locations where charcoal or ashes have been scattered or dumped.

37) **Campsite Furniture**: Assess the presence of campsite furniture such as log/rock seats, excessive rockwork around fire site, or tables. N = None, S = Some, L = Lots

38) **Access Trails**: A count of all trails (including vehicle tracks, count 1 per route) leading away from the outer campsite boundaries. For trails that branch apart or merge together just beyond site boundaries, count the number of separate trails at a distance of 10 ft from site boundaries. Do not count extremely faint trails.

39) **Human Waste**: Conduct a quick search of likely “toilet areas” up to 100 ft from campsite boundaries, generally in areas with the least visibility. Count and record the number of improperly disposed human waste sites based on the presence of TP or human waste.

40) **Litter**: Estimate the volume of visitor-related trash (including visible fire site trash and TP) onsite and within 100 ft of campsite boundaries in the following categories: 1= micro-garbage, 2 = handful,
3 = quart bag, 4 = gallon bag, 5 = 5-gallon bucket, 6 = trash bag, 7 = dump site (large items).

41) **Graffiti**: Assess the presence of graffiti on the campsite or within 100 ft of boundaries. N = None, S = Scratching marks, C = Charcoal marks, P = Paint, K = Chalk marks.

42) **Site Photographs**: Select a vantage point that provides the best view of the entire site and includes unique permanent features like large rocks or trees to positively ID the site location in the background. Also, position the camera to capture as much of the site groundcover as possible. The intent of this photo is to positively identify the site ***and*** record a visual image of its condition. Retake the photo if the lighting is bad or it’s out of focus. Set camera date and time to match GPS before beginning fieldwork. ***Enter the photo number(s).***

43) **Impact Comments**: Comments related to any impact indicators should be included here. Describe impacts or note any assessments that were particularly difficult or subjective, problems with monitoring procedures or their application, suggestions for clarifying monitoring procedures, descriptions of particularly significant impacts beyond site boundaries (quantify if possible), or any other comments you feel may be useful.

* **Collect all gear and clothing before leaving.**

Instructions on Use of Sonin Combo Pro: Read the Sonin manual. We will only use it in the target or dual unit mode. Turn main receiver unit on by pressing switch up to the double icons, turn target unit on and slide the protector shield up. The units power down automatically after 4 minutes of inactivity. Position units at opposite ends of segment to be measured, pointing the receiver sensors in a perpendicular orientation towards the target sensors. **Note:** The measurement is calculated from the base of the receiver and the back of the target, position units accordingly so that you measure precisely the distance you intended. Press and hold down the button with the line over the triangle symbol. The receiver will continue to take and display measurements as long as you depress the button. Wait until you achieve a consistent measurement, then release the button to freeze the measurement. Measures initially appear in feet/inches. To obtain conversions, press and hold the "C" button until the measure is converted to the units you want (tenths of a foot). Turn both devices off and store in protective case following use. Unit range is supposed to be 250 ft.; be careful and take multiple measures for distances over 100 ft. Under optimal conditions accuracy is within 4 in. at 60 ft. Device can be affected by temperature, altitude and barometric pressure, and noise (even strong wind). The units are not waterproof. **Batteries**: Carry spare batteries (2 9-volt alkaline). (Cost: $90)

Appendix B: Description of WinGate Outdoor Ethics Practices

WinGate Wilderness Therapy, which operates many of its programs in GSENM, describes environmental ethics of their program within the last section of their staff manual (WinGate). Specifically, the manual includes standards in regard to hiking. WinGate groups are to remain on any apparent trails. If there is no trail, they are to hike on rock, sand, or gravel. They are to stay in a line when hiking across these surfaces. They are to avoid walking across vegetation whenever possible, especially on hills. If they must hike across a vegetated area, they are to spread out to avoid producing a trail. WinGate wilderness therapy groups are to avoid walking across cryptobiotic crust, which is made up of small communities of organisms that appear as a black, uneven, and elevated crust upon sand surfaces. If walking across cryptobiotic crust is unavoidable, they are to walk in a straight line. They are to avoid walking through desert puddles and mud holes and avoid disturbing water sources.

The WinGate staff manual also includes behavioral expectations in regard to camping. Therapy groups are to camp on tough surfaces (rock, gravel, or sand) as much as possible. They are to avoid camping on cryptobiotic soil, islands of vegetation, or the green areas alongside rivers or streams. They are to camp no closer than 300 feet from water, historic, or pre-historic sites. WinGate wilderness therapy groups are to avoid disturbing lichen or varnish-covered stones. They are to wear soft shoes around their campsites, select routes within the campsites with robust surfaces, and alternate those routes in order to avoid producing conjoining trails. Mesh screens are to be used to strain water used to wash dishes in order to eliminate left-over food particles. These screens are to be positioned over an impression dug into gravel or sand when in use, and all left-over food particles are to be placed in plastic trash bags and carried out.

The WinGate staff manual also describes actions that should be taken in order to avoid environmental impacts in regard to campfires. All fires are to be built on fire blanket. The fire blankets are to be placed within an already-existing or created bowl-shaped area in order to better contain ashes. Fires are to be kept away from rocks in order to avoid “blackening” the surfaces. Staff and participants are to collect only dead and detached wood for burning. Wood is never to be broken off any dead or alive standing tree. WinGate wilderness therapy groups are to keep fires as small as possible. They are not to use fires as a means to keep warm. If employees and/or participants are cold, they are to add clothing layers and use their sleeping bags for extra insulation. They are to allow wood to burn to white ash, which requires using only small pieces of wood.

Human waste is another environmental issue that is covered in the WinGate wilderness therapy staff manual. Employees and participants are to avoid digging latrines and catholes in

areas where water visibly flows, such as sandy washes, even if they are dry at the time of the digging. They are to select a site that will receive maximum exposure to the sun in order to expedite decomposition. Catholes are to be at least eight inches deep, and latrines are to be at least ten inches deep, ten inches wide, and twenty inches long. All toilet paper and feminine hygiene products are to be placed in plastic trash bags and carried out.

After a WinGate wilderness therapy group has naturalized a campsite before departure, the senior trail instructor, leader of the day, and one other trail instructor are to examine the area to ensure that the site has been completely naturalized. Scuffed areas are to be covered with natural materials, footprints should be brushed out, and flattened or tangled grassy areas are to be raked. There should be no evidence of food particles or trash of any other kind. If any indication of the group's time within the campsite still exists at the time of the inspection, the entire group is to continue naturalizing the site. This procedure is to repeat until the senior trail instructor is content that the site has been completely naturalized. According to the staff manual, if WinGate's land use permit is suspended or withdrawn, or if WinGate receives a written or verbal warning as a result of a camp site not being entirely naturalized after use, the senior instructor involved with that site will be terminated.

Appendix C: Leave No Trace Dispersed "Pristine Site Camping" Guidance

The following guidance is excepted from the official Leave No Trace program book: Marion, J. (2014). *Leave No Trace in the Outdoors*. Stackpole Books.

DURABLE SURFACES

Actively seek out and use the most durable and resistant surface that's available to you for driving, riding, hiking, lunch or rest sites, and campsites. Explain what durable and non-durable surfaces are to your group and help them avoid areas of sensitive vegetation and soils.

Durable and Non-durable Surfaces. Durable surfaces include pavement, rock, gravel, snow/ice, and barren soils on well-established trails and recreation sites. Concentrating your travel and activity on non-vegetated durable surfaces spares vegetation from trampling impacts and minimizes the signs of your visit. If durable surfaces are unavailable, use non-vegetated areas of organic litter (leaves, pine needles) or dry grassy meadows. Studies show that grasses are the most durable type of ground vegetation, particularly those growing in open sun on dry to moist (not wet) soils. Dry grassy fields are generally the best sites for large-group camping or picnic events.

Learn to recognize and avoid non-durable surfaces, including tall broad-leafed herbs/forbs, ferns, wet soils, steep slopes, and cryptobiotic soils. Most broad-leaved herbs that grow in shade have stiff or weak stems that break easily, even under light traffic. In arid regions, cryptobiotic soils have a living "crust" of algae, cyanobacteria, fungi, lichens, and mosses. These crusts prevent soil erosion, retain soil moisture, and fix atmospheric nitrogen but they are extremely fragile and easily degraded by traffic.

Concentrate Activities on Established Trails and Recreation Sites. Research demonstrates that initial and low levels of trampling quickly remove most groundcover plants and organic litter, with substantial impact occurring in the first year of use. In contrast, recovery rates are very low, so the restoration of impacted trails and recreation sites to natural conditions can require 10-30 years! An important implication of these findings is that *visitors should concentrate activity on formal or well-established trails and recreation sites and avoid expanding them or creating new ones*. Your group's resource impacts are likely to be substantially greater if you travel off-trail into pristine areas. Visiting these areas requires greater knowledge and experience of low impact practices and considerable care to avoid the creation of lasting impact. For these reasons, only groups skilled in Leave No Trace dispersed use practices should venture off the beaten path.

CONCENTRATE USE IN POPULAR AREAS

In popular frontcountry or backcountry areas, concentrate your activities on marked formal or well-established trails and developed sites, including picnic areas, recreation and vista sites, and campsites. Staying on formal trails and well-established sites focuses your traffic on hardened or bare surfaces that resist further trampling impacts. Recognize that trails widen or form parallel

paths when people walk on the edges of trails, detour around obstacles, or walk side-by-side. Keep trails narrow and prevent these impacts by wearing appropriate footwear so you can walk single file in the center of trails—even where it's rocky or somewhat muddy (walk closely around the edges of deep mud-holes). If you are leaving deep prints (hoof, tire, or boot), the trail is too wet to use – find a drier alternative trail. Stay on the trail or a durable surface when being passed or to pass others. Never short-cut a trail, especially on switchbacks, as steep short-cuts quickly erode into gullies requiring costly restoration. Promote the recovery of closed trails and areas by avoiding them altogether.

Stick to Well-Established Trails and Campsites. Seek out and use only marked or blazed trails in heavily used areas. Formal trails are sustainably designed, safer and easier to use, facilitate faster travel, and are marked on maps so you are less likely to become lost. Studies reveal that most unmarked "informal" trails were created by visitors, and that they frequently degrade quickly and can impact sensitive or rare plant communities. Informal trail networks may also fragment wildlife habitats and hasten the dispersal of non-native plants. While some recreational pursuits require their use, such as accessing a fishing spot, you can help preserve natural areas by minimizing the creation and use of these unofficial, unmarked, and sometimes illegal trails. If your activity requires travel away from formal trails in popular areas, it's best to find and travel on a well-used informal trail, unless you can stay on more durable rock or gravel surfaces. In particular, avoid using faint trails or areas where impacts are just beginning to show, to promote their recovery.

When picnicking or camping in heavily used areas, choose only designated or legal well-established sites. Check with the land managers or owners for advice on selecting a site and on applicable camping regulations, permits, or low impact practices. Some land managers require camping permits and use of designated sites; others simply promote the use of well-established campsites. For all activities, choose a well-established site you can use without enlarging. If you have too many people or tents, divide into smaller groups and use additional sites. Avoid expanding a site's size by confining your activities on the most durable and previously disturbed surfaces. Preserve native vegetation by not stepping on plants and avoiding traffic in adjacent offsite areas. Most importantly, note that *recreation sites enlarged from just one group's use rarely return to their original size, as subsequent groups often continue using the newly expanded areas*.

Never create a new recreation site or campsite and avoid using lightly impacted sites to promote their recovery. Recreation site and campsite proliferation are significant problems in many areas. Ask managers to identify likely possible locations that meet the needs of your group. Check for guidance on group sizes, number or placement of tents, food storage, campfires, and firewood sources. On campsites, place all tents, gear, and your cooking area near the center of your site. Consider using larger capacity tents for youth groups to minimize your camping "footprint" and placing them close together. Confining your activities to the core barren area keeps your site small, protects surrounding vegetation, and prevents development of disturbed "satellite" sites in offsite areas. However, in bear country it's advisable to separate the sleeping and cooking/food storage areas. Land managers generally provide special guidance on camping practices in bear

country.

Good Campsites Are Found, Not Made. Spend time finding your perfect campsite; avoid remodeling or altering a site. For example, bring a lightweight chair instead of moving logs and rocks to sit on. Modern tents and sleeping pads allow greater flexibility and comfort in selecting a durable, dry, and comfortable tent site. Hammocks provide an even lower impact option, but when possible pitch them over a spot with little or no vegetation and use wide "tree-saver" straps instead of ropes, which can cut into tree bark. Ditching soils and removing vegetation when pitching tents and tarps is never appropriate. Portable stoves and even tables allow you to prepare meals anywhere without a campfire.

Protect trees and shrubs around your campsite from damage. Take care not to break off branches when securing tent, tarp, or clotheslines, and when suspending hammocks or food. Don't use wire or nails and if necessary, place a stuff sack, an old piece of carpet or other padding under ropes to protect bark. Likewise, place lanterns where they will not singe bark. Even breaking off a tree branch for firewood creates an ugly scar and can expose the tree to insects and disease (see *Minimize Campfire Impacts* for information on collecting firewood). When camping with stock, use provided hitch rails, well-rigged high lines, portable fencing, or hobbles to restrain your animals without tying them directly to trees. Ask about the best stock confinement options for the area you plan to visit. Come prepared to confine your animals.

Leave your campsite clean and natural looking—as *you* would like to find it. Remember that you are a host to those who use the site after your visit and they will notice your hospitality, or lack of it! Litter, graffiti, tree damage, unburied human and pet waste, spilled food, and unsightly fire rings are all *avoidable* impacts. By taking the time to pick up after ourselves and others, we and the environment all benefit.

Large Group Activities. If you have a larger group, stick to popular areas and ask land mangers about the availability of group use picnic or camping sites (which often require advance reservations). If such facilities are not available, secure approval to hold large group picnics or camping events in dry grassy fields. Be sure to have contingency plans for moving gear to and from the activity areas in the event of heavy or sustained rains or snow. Otherwise vehicles can become stuck or create severe rutting damage. Monitor vegetation impacts and shift activities if you see the loss of vegetation cover beginning to occur.

DISPERSE USE IN PRISTINE AREAS

Does your recreational activity truly require off-trail travel or visiting pristine areas? If not, then stick to formal marked trails and recreation sites whether in the frontcountry or backcountry. Recognize that the resource impacts of your visit on formal, designated trails and sites are often quite low. When you venture away from these impact-resistant trails and sites, the potential for harming natural resources is substantially higher. Accept the personal responsibility to "Leave No Trace" of your visit if you must venture off-trail.

Off-trail Hiking Practices. As previously noted, you may encounter informal (visitor-created) trails and sites, often only distinguishable from their formal counterparts by their lack of blazings, markings, or signs. Consult with land managers for specific guidance, but understand that off-trail traffic frequently leads to the proliferation of these informal networks of trails and sites. Furthermore, studies show that visitor-created trails and sites are more susceptible to resource impacts because they lack professional design, construction, and maintenance.

If your activity requires travel into low-use pristine areas, or far away from formal trails and recreation sites in popular areas, disperse your footsteps and activities to avoid repeat traffic and visible impact. If each person takes a slightly different route, a distinct trail won't form because no single plant receives multiple footfalls. Your objective in these areas is to avoid concentrated hiking or activity that leaves visible impact to plants and soils. Avoid using informal trails or recreation sites, particularly those that are not well-used, to promote their recovery. Research shows that even a few passes by hikers or a single night of camping can substantially delay their recovery to natural conditions. Because low levels of repeat traffic can create new trails and recreation sites, dispersal is generally an effective policy only in areas that receive low use.

Avoid Leaving Visible Impact. The degree of dispersal needed depends on the surfaces your group encounters. Rock surfaces that lack plant or lichen cover can tolerate concentrated traffic, as can barren gravel shorelines, dry washes, and snow or ice. Walking single file is acceptable only when doing so leaves no obvious disturbance to vegetation, organic litter, or soils. If you must travel or camp on vegetation, look for dry grassy meadows—grasses have flexible stems and leaves that resist damage and recover quickly. In contrast, plants growing in shade, such as ferns and weak-stemmed broad-leafed herbs, are highly susceptible to trampling damage—avoid these! When traveling or camping in forests, find and use areas with the most dense canopies that support little or no vegetation groundcover. When in doubt, periodically examine the effects of your group's activities and minimize impact by increasing dispersal or use of durable surfaces.

On non-durable surfaces, even low or inconsistent traffic along the same routes quickly leads to the development of informal, visitor-created trails. Cross-country hikers quickly discover that topography and vegetation acts to concentrate their traffic to routes with the fewest obstacles. Resist this tendency and keep your group broadly dispersed, with single file traffic only on the most durable rock, gravel, or snow surfaces. Recognize that dispersed travel requires constant vigilance and is considerably slower and more difficult than hiking along a trail. Plan your schedule accordingly. Failure to disperse your group's traffic will accelerate the formation of informal trails that can quickly attract further use and impact.

Dispersed Camping. Dispersed or "pristine site" camping is generally not permitted or is discouraged in frontcountry areas as the potential for repeated use is simply too great. In less-visited backcountry areas, camping impacts can be minimized by selecting the most durable and resistant spot available and by staying only one night. Avoid *any* locations that show pre-existing camping disturbance to promote their recovery. When possible, also avoid areas that are highly visible to other visitors, vegetated shorelines, and areas with signs of wildlife. Moving a few sticks or rocks to erect a tent is fine, just return them before your depart. In forested areas hammocks

make it even easier to “leave no trace” of your overnight stay.

Locate cooking areas on the most durable site available, like a large rock slab, gravel, or barren area. *Unless durable surfaces are available, avoid creating trails by limiting your trips and varying your route to water, sleeping, and cooking areas.* Monitor the effects of your activities, concentrating use on the most durable surfaces or dispersing your activities—whatever is necessary to avoid creating lasting impacts.

Before departing, naturalize and disguise the site—your objective is for no one to see or use the site again. Add leaf litter or pine needles to any scuffed up areas. Fluff up flattened vegetation and organic material and replace any rocks or sticks you may have moved. If possible, place a log or branches across your tenting and cooking areas to deter their future use. Almost any forested setting can accommodate a single night of use each year without showing permanent effects; grassy areas can handle several nights. If you need to stay in one area longer, plan on moving your campsite when lasting vegetation or soil impacts begin to show.

Protect Water Resources. In most areas, sand and gravel bars along rivers or the ocean are durable surfaces that are generally suitable for dispersed camping. Avoid lakeshores and the banks of streams as such areas are often popular with hikers, anglers, or boaters, and their use is likely to attract repeated camping. Finding a secluded spot away from water with durable or non-vegetated surfaces is best, or a hidden grassy spot. When traveling to get water take different routes and avoid steeper slopes that could erode soil into waterways. Where possible, also avoid camping near water in arid regions—these areas are ecologically important because they support diverse plant and animal populations that need water to survive in harsh dry environments. Additionally, plants and animals in arid environments are usually more sensitive to recreation disturbance.